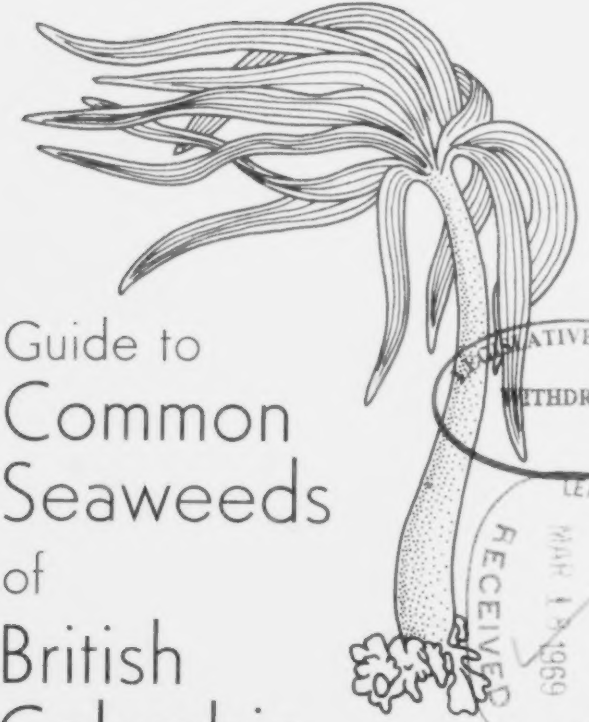
B.C. Govt

BRITISH COLUMBIA PROVINCIAL MUSEUM
DEPARTMENT OF RECREATION AND CONSERVATION

HANDBOOK No. 27



LEGISLATIVE LIBRARY
WITHDRAWN

LEGISLATIVE LIBRARY OF ONTARIO
RECEIVED
MAR 13 1969
TORONTO

Guide to Common Seaweeds of British Columbia

By ROBERT F. SCAGEL
Department of Botany
The University of British Columbia

VICTORIA, B.C. SEPTEMBER, 1967

BRITISH COLUMBIA
DEPARTMENT OF
RECREATION
AND
CONSERVATION

The Honourable William Kenneth Kiernan
Minister

D. B. Turner
Deputy Minister

104-03977/

BRITISH COLUMBIA PROVINCIAL MUSEUM
DEPARTMENT OF RECREATION AND CONSERVATION

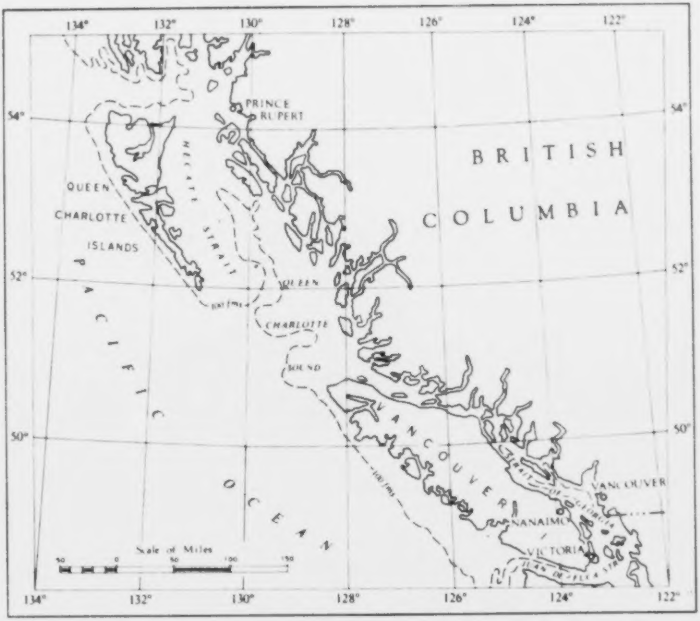
HANDBOOK No. 27

Guide to Common Seaweeds of British Columbia

BY ROBERT F. SCAGEL
DEPARTMENT OF BOTANY
THE UNIVERSITY OF BRITISH COLUMBIA

ILLUSTRATIONS BY ERNANI G. MEÑEZ

Printed by A. SUTTON, Printer to the Queen's Most Excellent Majesty
in right of the Province of British Columbia.
1967


134°
132°
130°
128°
126°
124°
122°
54°
52°
50°
PRINCE RUPERT
BRITISH COLUMBIA
QUEEN CHARLOTTE ISLANDS
HECATE STRAIT
QUEEN CHARLOTTE SOUND
100 fms
PACIFIC OCEAN
VANCOUVER I
VANCOUVER
NANAIMO
VICTORIA
STRAIT OF GEORGIA
JUAN DE FUCA STR
Scale of Miles
50
0
50
100
150

Map of Coastal Portion of Province.

TABLE OF CONTENTS

	PAGE
Table of Contents	3
Introduction	5
Acknowledgments	6
History	6
Uses and Importance	9
Distribution and Ecology	9
Collection and Preservation	13
Life Histories	22
Structure and Reproduction	32
Identification	33
Selected References	34
Key to Classes of Marine Plants	35
Green Algæ (Chlorophyceæ)	36
Key to Genera of Green Algæ	36
Brown Algæ (Phæophyceæ)	74
Key to Genera of Brown Algæ	74
Red Algæ (Rhodophyceæ)	166
Key to Genera of Red Algæ	166
Marine Seed Plants (Sea Grasses)	312
Key to Genera of Marine Seed Plants	312
Glossary	320
Systematic Index	327

Fair spread on pages white, I saw arrayed
These fairy children of a sire so stern;
Their beauty charmed me;
—APPLETON.

Guide to Common Seaweeds of British Columbia

INTRODUCTION

With a growing awareness of the sea and the importance of its resources, there has been an increasing demand for a popular account of the seaweeds of British Columbia. This handbook has been prepared primarily to meet the less critical needs of the layman, or one casually interested in seaweeds and their natural history. It is only an introduction to this bizarre group of plants and is not intended for the specialist. It is still impossible to present a comprehensive treatment of all the seaweeds which would be sufficiently complete for the phycologist, or specialist in marine algæ. Much research of a monographic nature is needed, and many of the local species must be compared critically with plants from other geographic areas before the more detailed needs of the specialist can be met. However, it is possible to present a handbook giving sufficient information for the more observant person interested in natural history to identify to genus, and in some instances to species, many of the more common and conspicuous marine algæ.

In addition to the larger, attached algæ, some fungi, phytoplankton, and a few seed plants, such as *Zostera* (eelgrass) occur in the sea. Because of the microscopic nature of phytoplankton, these groups of algæ are beyond the scope of this handbook. The marine fungi are also microscopic and are not considered here. There are only a few species of marine flowering plants. However, since they are often abundant and also frequently referred to as "seaweeds," the species of sea grasses occurring in British Columbia are included in this handbood. Other groups of plants—liverworts, mosses, and ferns—do not have marine representatives.

Thus, this treatment of seaweeds is by no means inclusive of all the marine plants, nor does it cover all the larger marine algæ of British Columbia. About 500 species of attached marine algæ occur in British Columbia. Of these, only the more common and conspicuous species are described and illustrated in this handbook.

Authoritative treatments for some groups of algæ on the west coast of North America were published prior to 1925 (Setchell and Gardner, 1920 and 1925). But these were not comprehensive, and there is still no modern reference dealing with all groups of the larger marine algæ occurring on this coast. Smith's (1944) " Marine Algæ of the Monterey Peninsula, California " together with Hollenberg and Abbott's (1966) " Supplement to Smith's Marine Algæ of the Monterey Peninsula " provide the closest approximation to a comprehensive manual, but because of their restricted geographic scope they are of limited use in British Columbia. A popular book on the natural history of seaweeds of Northern Washington was published in 1956 (Guberlet), but this is limited in its scope and of little taxonomic value to the more observant collector interested in studying and identifying marine algæ.

It is hoped that this illustrated guide to the common seaweeds will stimulate interest in this bizarre group of plants and, in so doing, encourage others to contribute to our knowledge of the distribution and biology of this little-known assemblage of plants in British Columbia.

ACKNOWLEDGMENTS

I would like to acknowledge the contribution of Mr. Ernani G. Meñez, who prepared the drawings used to illustrate this handbook. The preparation of the illustrations was supported by a grant from the President's Research Fund, University of British Columbia.

HISTORY

The first seaweed was collected on the west coast of North America 175 years ago. However, progress in marine botany in general has been relatively slow. This has been partly because of the difficulty in getting to or observing the marine plants, and also because relatively few botanists have been actively studying them. They have been one of the most neglected of all plant groups.

It is interesting to note how the development of our knowledge of the marine algæ has been intimately associated with, although incidental to, the political history of the Pacific Coast of North America, and how it has been linked with some of the early voyages of discovery in the North Pacific by early British, Spanish, Russian, and American navigators.

As a profession in the post-Linnæan period, botany was still largely dependent for its existence upon the patronage of royalty and the well-to-do. At this time the efforts of Sir Joseph Banks, who had a deep interest in botany and was later president of the Royal Society (1778–1820), were widely felt. As a young man, Banks accompanied Cook upon his first voyage of discovery, and was responsible for a scientific staff on this expedition. However, despite his personal friendship with George III and his wide influence, his plans for subsequent voyages with Cook did not materialize. Hence, in 1778, when Cook visited the north-east Pacific for the first time, no staff of naturalists was on board. However, a young midshipman, George Vancouver, accompanied Cook on this voyage and returned in 1791 to the west coast of North America with the first botanist to collect marine algæ in this area. This man was Archibald Menzies.

Menzies had visited the north-east Pacific with Colnett between 1786 and 1789 on board a fur-trading vessel, the *Prince of Wales*. He had collected plants in British Columbia on the west coast of Vancouver Island, on Banks Island, and in the Queen Charlotte Islands. It has been stated that he collected no marine algæ during this early expedition, only on the later voyage with Vancouver. However, from dates on some of Menzies' specimens which are deposited in the Royal Botanic Garden, Edinburgh, it is apparent that he did collect a few marine algæ during the first as well as on his later visit on the west coast of Vancouver Island, and at other points along the Pacific Coast of North America from California to Alaska. Most of Menzies' specimens of algæ were sent to England, where they were described and illustrated by Dawson Turner between 1808 and 1819.

Collection data assembled during the early days of botanical exploration in the north-east Pacific were extremely sketchy. For example, data such as those of Menzies on specimens from Monterey and San Francisco in California and Nootka Sound in British Columbia are frequently vague, in some instances even bearing the designation " north-west coast of North America." Hence, in some instances we can now only speculate as to exactly where many of these early collections were made.

Subsequent to Menzies' visit, small collections were made from time to time in central California and elsewhere in the north-east Pacific by a number of collectors. These were all sent to European phycologists, such as C. A. Agardh and J. G. Agardh in Lund, Sweden, and W. H. Harvey in Dublin. It was not until the middle of the 19th century that the first comprehensive collection of marine algæ was made on the west coast of North America in British Columbia. This historic collection was made between the years 1859 and 1861 by David Lyall, a medical officer, in the vicinity of the British naval base at Esquimalt, British Columbia. It comprised 100 species of marine algæ (from the same general area about 500 species are now known). These specimens were sent to Harvey at Trinity College in Dublin for determination. Thus, until late in the 19th century the botanists working over the early collections (few of which were collected by phycologists) were all located in Europe. It was not until the end of the 19th and early in the 20th centuries that visiting and resident phycologists actively began work on the Pacific Coast marine flora.

Primarily as a result of the activities of W. A. Setchell, who began publishing in 1891 on the Pacific Coast marine algæ, the establishment of broad floristic areas along the Pacific Coast from California to Alaska were outlined by 1925. Some of the contemporary phycologists who contributed significantly to this knowledge during this early period were N. L. Gardner, T. C. Frye, and G. B. Rigg in Washington; DeAlton Saunders and N. L. Gardner in California; DeAlton Saunders in Alaska (on the Harriman Alaska Expedition); and F. S. Collins in British Columbia, based on a number of collections made at several points on Vancouver Island at the turn of the century by John Macoun, Canadian Government botanist. Later, significant contributions to our knowledge of the marine algæ of this coast were made by H. Kylin in central

California and at Friday Harbor, Washington; by G. M. Smith at Monterey, California; and M. S. Doty in Oregon.

In more recent years there has been a renewed interest in the marine algæ of British Columbia, as well as elsewhere on the coast and in the world at large. The number of phycologists has steadily increased. An annotated check list was published in 1957 (Scagel) giving a systematic list of the attached marine algæ in British Columbia and Northern Washington and listing all of the pertinent literature up to that date, and a further more detailed treatment of the Chlorophyceæ (green algæ) for this area was published in 1966 (Scagel).

USES AND IMPORTANCE

A detailed account of the direct and indirect uses of seaweeds and seaweed products and those species occurring in British Columbia which are potentially important in this regard was published in 1962 (Scagel). The reader is referred to this paper for more detailed information on this subject.

Most people are aware that terrestrial forms of life—both plant and animal — are all dependent on photosynthetic plants either directly or indirectly for their existence. Similarly, in the ocean all marine life is dependent on the photosynthetic populations which are able to exist in this unique environment. Whether an organism lives near the surface in an illuminated environment or in perpetual darkness at the bottom of the deepest part of the ocean at a depth of several miles, it is entirely dependent directly or indirectly on those chlorophyll-bearing plants which occur near the surface of the sea. Here the photosynthetic plants convert the energy from light to the organic food required for their own use and for all other forms of life in the sea. Though they are very minute, the phytoplankton play a most important part in this role, not only in the coastal regions, but also far from shore. In the coastal region the larger attached marine photosynthetic plants also add significantly to this organic contribution.

DISTRIBUTION AND ECOLOGY

No attached plants can live at great distance from the shore because of the extreme depth of the ocean and the continual darkness that exists in all but the uppermost portion of this immense underwater world. It is only along the continental shores, where the ocean has extensive shallows, that the larger attached algæ can become established. Even here it is only possible for attached plants to occur in relatively shallow water. The depth to which they can penetrate varies from place to place, depending on the water characteristics. For example, in tropical regions where sea water is notably clear, sufficient light for photosynthesis penetrates to a considerable depth and permits attached marine plants to grow at depths of several hundred feet. However, along the Pacific Coast of North America, especially along the coast of British Columbia, the cold water of the North Pacific is more turbid. Much silt and other suspended material enters the sea in the great volumes of fresh water that are added each year by large rivers in this area. This suspended particulate material reduces the clarity of the water; it diminishes the light intensity rapidly and restricts the depth to which light can penetrate in the coastal water. Hence, there are few attached marine algæ occurring along the coast of British Columbia in depths over 100 feet.

Most visitors to the seashore have seen the occasional seaweed cast up on the beach. Aside from noting the " popping " of *Fucus* (rockweed), as it is trampled underfoot, few are probably aware that the plants they see are only a few of nearly 500 species of seaweeds that are known to occur in British Columbia. Some of these seaweeds are unknown in other parts of the world; some are cosmopolitan and similar to those found in both northern and southern hemispheres as well as in eastern and western hemispheres; others link our coasts with those of the Aleutian Islands, the Kamtschatka Peninsula, and northern Japan. The largest marine algæ known to man occur on the Pacific Coast of North America, and some species of these are present on the coast of British Columbia.

A few large seaweeds, like *Sargassum*, become detached and at times float freely. But most seaweeds need a firm substrate upon which to become established in order to complete their life histories. Thus, a stable rocky shore, especially with extensive shallows and tidepools, is the best environment for a luxuriant algal growth. Mud, sand, pebbles, and even small boulders in exposed regions, because they provide little or no anchorage and are very unstable when subjected to strong wave action or currents, usually provide an unsuitable substrate for algal growth. However, in quieter places, loose gravel and boulders may provide a suitable substrate for certain seaweeds.

It is not difficult to distinguish most algæ from other plants. They have chlorophyll and are, therefore, photosynthetic plants, in contrast to the saprophytic and parasitic fungi which lack this photosynthetic pigment. However, they do not always appear green in colour.

Many algæ have leaf-like, root-like, and stem-like parts. In some instances these structures are very similar in their gross morphology to the organs characteristic of flowering plants. However, they are neither functionally nor anatomically comparable. For example, structures referred to as holdfasts with branched root-like haptera serve only to anchor the plants to the substrate. Only in the marine seed plants, such as *Zostera* and *Phyllospadix*, and in terrestrial higher plants and certain fresh-water aquatic plants is there a true root. A root is a very complex organ, ideally specialized for absorbing from the substrate essential materials for plant growth and development. Similarly, the leaf-like structures of algæ are not true leaves, as in higher plants. They are usually called laminæ or blades. Most of them are very simple anatomically. They do not have vascular tissue in veins for conduction, as are present and and necessary in higher plants. However, these leaf-like parts of the marine algæ do have photosynthetic tissues and, therefore, are capable of manufacturing food, just as leaves do in flowering plants. But in this respect the leaf-like parts of marine algæ, although more efficient, are no different in function from the superficial region of any other part of the alga.

Similarly, the stem-like parts of algæ, which are usually referred to as stipes or stalks, do not have the well-differentiated supporting and vascular tissues that occur in the stems of higher plants. Just as the stems of many higher plants have photosynthetically active superficial tissues, the surface cells of the algal stipes are also photosynthetically active.

On the whole, the algæ are a relatively simple group of plants. They lack the high degree of anatomical differentiation which occurs in higher plants. Nevertheless, they are well adapted to the aquatic environment in which they live so successfully. However, because they lack any conducting systems, all parts of the algal body must be in intimate contact with the aquatic medium in which the plant lives. This is imperative, because it is directly from the water surrounding it that the alga obtains not only water, but all the dissolved substances (gases and essential minerals) needed throughout the plant body for its nutrition, growth, and reproduction.

Many species are never exposed to the atmosphere; this intimate and direct dependence on water requires that they be constantly surrounded by the aqueous medium; these are the subtidal species which can only be seen by wading, diving, indirectly by dredging, or when they are cast up on the shore. Other marine algæ can withstand varying degrees of exposure to the air and sun; these are the intertidal species which can exist in a zone where they are periodically covered and uncovered by the tide as it rises and falls. Preferences within this narrow intertidal strip are apparent, and at low tide horizontal bands of characteristic vegetation are strongly marked, each one defined by its own group of species. A few species, such as *Prasiola*, may even exist above the highest level to which the tide rises, receiving only splash and spray from waves.

Thus the algæ, in general, are much more intimately dependent on their environment than higher land plants, which have developed complex but effective mechanisms for meeting their requirements. For example, most of the water needed for photosynthesis in the leaves of a tree must come from the soil. Hence, the land plant must have an efficient mechanism for absorbing water at the point where it is available and conducting it to the point where it is needed. This is done through the root hairs and continuous vascular tissues (xylem) leading through the root, stem, and eventually into the leaves. On the other hand, the root of most higher plants is buried in the soil in total darkness. It is unable to carry on photosynthesis under these conditions, although it provides a necessary anchoring system and contact with essential water and minerals.

However, since the root cells require energy, just as any living cell does, they must obtain the food required to produce this energy from the photosynthetic portion of the plant body—chiefly the leaves. Here again the well-differentiated vascular tissue (phloem) of the leaves, stem, and root permits conduction of these substances from the place of manufacture in the plant body (chiefly in the leaves) to all points where they are needed and locally unavailable.

Just as there is a vertical distribution of marine algæ, varying with the range of ecological habitats and degree of exposure presented, similarly the horizontal distribution varies significantly. It has already been mentioned that a rocky substrate provides the most stable site for the attachment of marine algæ, and that some species are adapted to less stable sites. Hence, to see the total array of marine algæ in an area the collector must look at all the different types of habitat, both vertically and horizontally. Other oceanographic conditions (both physical and chemical) vary from place to place and provide differing habitats. Some of these places are more suitable for marine algal growth than others. But here again we find almost always a few, sometimes different species in each of the different habitats. On the open coast, in areas exposed to high-salinity water where the sea is very active and heavy surf occurs, there is an entirely different composition to the marine flora than in the more sheltered, brackish water of the mainland inlets and in the river estuaries. For example, near the brackish sandy estuary of the Fraser River there is a relatively impoverished marine flora; on the east coast of Vancouver Island, in the rocky area north of Nanaimo, where the salinity is much higher and the coast is relatively protected from strong wave action, a much more luxuriant flora occurs; and on the west coast of Vancouver Island at Sooke and near Port Renfrew where high-salinity water occurs along a predominantly rocky shore with varying degrees of wave action and heavy surf, the flora reaches its greatest diversity and abundance.

COLLECTION AND PRESERVATION

Even in summer, except in somewhat anomalous regions such as Qualicum, Ladysmith, and other confined embayments in British Columbia, the water along the North Pacific Coast is notoriously cold. Hence, except for the well-insulated diver, collecting in deeper water is far from comfortable. But diving is certainly the only way to collect subtidally and to appreciate the fascinating algal " forests " that occur in this relatively unexplored underwater world.

For the less venturesome, dredging provides an indirect means of sampling the subtidal flora, but it is far from adequate as a method of collecting. And so our knowledge concerning these plants that are never exposed and in deeper water is still very fragmentary. However, at extreme low tide, with a pair of hip boots, in the shallower water (even in the subtidal regions which are never exposed) and with the certain knowledge that sooner or later he will slip, accidentally fill his boots and perhaps even undergo total immersion in the icy water, the collector's efforts will be rewarded within arm's reach by a great variety of bizarre plants. If he has a free hand, a stout walking-stick will prove most useful in walking on the rough and slippery terrain of a rocky, seaweed-covered shore.

For the still less venturesome, the intertidal region and its pools are readily accessible during certain times of the day to varying degrees. During low-tide periods, many attached algæ are left lying prostrate on the shore in the intertidal region. But a word of caution is in order—the slippery algæ-covered rocks are much less kind than the cushioned fall on water if the unwary collector slips!

Collecting marine algæ on a rocky or boulder beach covered with a profusion of plant growth may be quite dangerous, and extreme care should be taken. Not only are the rocks slippery, but the collector will need to be careful to avoid twisting an ankle if his foot slips into a rocky fissure, into a pothole, or between boulders. Collecting in a bathing costume, shorts, or without adequate protection to the legs and arms can be especially dangerous, because of the chance of running into sharp rocks and barnacles. Tennis shoes are not very satisfactory, especially if the ankles are exposed and subject to injury from sharp rocks and barnacles. If one can tolerate wet feet and legs and the temperature of the water, basketball shoes (which come above the ankle) with thick rubber soles and deep corrugations are most suitable. However, the collector must remember that the plants he seeks are aquatic, and if he wishes to succeed in the pursuit of the algæ in cold water, he must strive to keep warm and dry, but expect to get cold and wet and experience some loss of dignity in dress and movement. Whatever his fate, he can expect some strenuous activity in his pursuit!

Knowing where there is the greatest profusion of seaweeds and the type of environment he faces, the collector will now want to know how he can best collect seaweeds; what he should select in the field; and how he must handle the specimens collected for study, identification, and preservation.

First, in order to explore the intertidal area it will be necessary to determine the tidal characteristics of an area by consulting a tide book, or often a local newspaper will give the days of the month and the times at which the tide is low and high. It is best to start collecting in an area at least two hours before low tide, to work close to the water's edge and follow the receding water, collecting as the tide falls, until it starts to rise again. Then the collector should follow the tide as it rises, examining the successively higher levels and deeper pools in the intertidal zone. At low tide, fringing offshore reefs are often accessible by wading, but one must keep alert to avoid being cut off from the shore by the rising tide.

Along wave-swept shores, often following storms, many seaweeds are torn loose and cast up in a fresh condition on the beach. Unless they have been drifting for some time at the surface, seaweeds which are freshly cast up may be in excellent condition and provide a very good sampling of the subtidal flora of an area which may not be otherwise accessible.

Individual preferences exist as to the type of collecting-gear most suitable. A plastic bucket is, in the author's opinion, most efficient. The wide mouth permits ready access to the contents, and the handle can be suspended on the arm, leaving the hands free. Since the plastic is light, the collector can often manage two buckets at the same time, even when they are filled with specimens, and if he loses his footing and falls, less serious results are likely than if the bucket he is carrying is metal and relatively inflexible. If larger plants are being collected, a cloth sack, or an old pillow case is often useful. Various sizes of plastic sacks are useful for sorting different sizes of specimens as they are collected. Small bottles or vials, preferably of plastic with screw tops, are most useful for the very small specimens, which might be lost amongst larger ones. But unless the collector has a microscope for later study of his specimens, he will probably have to overlook or neglect many of the beautiful small specimens.

Since the algæ are generally securely fastened, a strong knife or an old file, sharpened at one end, to scrape or pry them from the rocks is essential. A strong putty knife is also quite useful for the same purpose.

If the rock, pebble, or shell is small enough, the specimens may be taken while still attached and removed with a portion of the substrate; the specimens can be removed carefully later. Epiphytic forms can be cut from the surfaces of the larger algæ together with a portion of the substrate alga with a knife. Collecting in shallow water can often be accomplished with a small rake or a three-pronged cultivator while wading, or from a boat in shallow water.

For the lime-encrusted coralline algæ, a geologist's pick or a hammer and a cold-chisel are indispensible for collecting the stony plants.

The collector will not find all species of seaweeds in plain sight. He must be observant and lift up larger plants and look for small ones underneath them. He must also look along the edges of rocks and in crevices, in pools; in fact wherever even the slightest amount of light occurs there may be found another group of species, unique to their peculiar ecological niche. Channels where the water surges in and out in the rocks on the open coast are exceptionally fine places to find marine algæ, but the collector must keep a wary eye on the waves, as an occasional large one may fill his boots or sweep him off his feet and carry him out to sea!

At low water the collector should wade as deep or dive as deep as he can; he must look under overhanging rocks, under the larger plants and on them for small forms and epiphytes. SCUBA (self-contained underwater breathing apparatus) in the hands of a trained and experienced observer will greatly extend the vertical range of the collector. Even without SCUBA, with only a face mask, swim-fins, and a snorkel, much of the upper subtidal region can be sampled quite efficiently. With a rubber exposure suit, even at a temperature of 52° F. and less, the collector can remain in the water comfortably for an hour or more before becoming chilled. But for the amount of effort entailed in the use of SCUBA, except where the collector has a specific purpose in mind, the results generally yield a more limited collection than one can often readily obtain at low tide in the intertidal zone and by wading. Some especially adapted species, of course, will be obtained only by sampling in deeper water. While diving, certain problems also arise. It is difficult to transfer smaller forms under water to a collecting container. A plastic sack with a plastic bottle and small vials (from which all air has been expelled to keep them from floating out of reach to the surface) are fairly efficient for collecting small plants. Some sort of coarse net in the form of a sack is best for collecting the larger species under these circumstances. For lack of anything better, and to keep both hands free, one ardent collector the author knows used to stuff specimens into his bathing trunks!

There are many other unique types of substrate that must be searched to obtain the greatest assortment of seaweeds, such as wharf piling and floats, breakwaters, floating and submerged logs.

For viewing while wading in shallower water, the collector may find a glass-bottomed bucket or box most useful. This type of viewing apparatus cuts down surface reflection and permits clearer visibility through the water. A face mask held in the hand or worn on the face with the mask just below the surface will serve a similar function.

Although no universal preservative can be recommended for all species of algæ, or for all purposes, in general, and where mixed collections are necessary, 3–4 per cent commercial formalin (preferably neutralized with borax) in sea water is most satisfactory. Most of the seaweeds will maintain their colour fairly well if kept in the dark after preserving. However, they will usually soon bleach out to an opaque creamy white if kept in strong light for any length of time. The brown algæ often lose some of the brownish pigment, soon after collecting, and may subsequently appear somewhat greenish, even before they can be transferred to preservative. Small specimens should be kept separate when collected, either folded up in pieces of paper or put in small bottles or plastic sacks so that they do not become lost amongst the larger plants.

If the collector must keep small delicate forms for some time before returning home, it is often well to take along vials about half full of 3 per cent formalin in sea water, as the delicate algæ may putrefy very quickly if kept severely cramped in a small volume of water without preservative. It is convenient for collecting in the field to have the preservative for small specimens measured out in advance in wide-mouthed containers, marking on the bottles or vials the level to which sea water should be added in the field before preserving the specimens. Larger forms, with a few exceptions, may be kept quite safely for several hours, but it is well to keep them moist, and it is very important to keep them as cool as possible. If larger specimens must be stored for a longer period they should be preserved in 4 per cent formalin and kept in opaque or dark bottles or stored in the dark. Coarse specimens may also be preserved for some time by salting like fish, but this method is not generally recommended. Commercial-grade formalin can be obtained most cheaply from a chemical supply company or an agricultural supply house, but it can also generally be obtained (usually at significantly higher cost) from any druggist or hospita laboratory. A mixture of alcohol (even Scotch whisky in an emergency) and sea water in equal parts may also be used as a preservative. But because of the bleaching effect of the alcohol, which removes some of the plant pigments, it is less desirable if specimen are to be mounted later for the herbarium.

If specimens are to be observed microscopically, they can be studied best in the living or liquid-preserved condition. However even dried material can be soaked in water after many years in the herbarium and the specimens will recover enough to be quite satisfactory for microscopic examination. Liquid-preserved specimen may also be taken out of the preserving fluid later if desired, washed in fresh water, and treated for drying as outlined below.

Too much plant material should not be crowded in too littl preservative, especially when freshly added to the preserving flui in the bottles. Sufficient liquid should be present to make sure specimens are well mixed with it. However, when preservation has been complete (after a few days), the plants may be packed more tightly in containers of fresh preservative.

Loose rocks, pebbles, or shells should not be included in the preserving container, as they may move about in transport and damage the specimens. Specimens should be kept separate as to each locality, and labels appropriately identifying the material should be kept with each collection.

If preserved specimens are to be stored for some time before further study or treatment, they may be placed in metal 4-gallon liver cans; the lids may be soldered shut for shipping. Provided the cans are not damaged, coarser specimens can be stored in this way for several years without adverse effect, removed for study, and dried for the herbarium.

Labels of a heavy-quality paper (bond with a high rag content so that they do not end up as a soft pulp) are suitable; these may be written on in soft (3B or HB) pencil and put directly in with the preserved specimens. Labels should bear a serial number and preferably also name of collector, date, and place of collection; these data should also be placed in a notebook. Labels printed in India ink or typed are best if the situation permits.

If conditions are suitable (and they are rarely so in the British Columbia climate), specimens may be dried in the field. If it is raining or the humidity is high, it is better to preserve the specimens, otherwise they are apt to decay very rapidly, and the collector may lose them. With favourable weather small specimens may be partially dried in the sun, but when still soft they should be placed between sheets of newsprint for further drying. Large specimens (such as kelps) may be partly dried in the sun, and when about the consistency of leather they may be rolled up and placed in a box for further drying. When once dry, specimens should be kept dry, but they should not be dried too quickly. The heat in proximity of the galley on a ship is a good place to store but not to dry, as they will dry too quickly. In general, unless one is on an adequately equipped vessel or working in a building close to the collecting-site, it is best to preserve all specimens and proceed with drying when a more suitable place and time can be used for this purpose.

Dried specimens maintain their natural colour better than liquid-preserved specimens. When specimens are brought in from the field in the fresh condition, they may be prepared on sheets of paper for preservation in dried condition or they may be kept in liquid preservative. Some of the larger forms are often dried and kept permanently in boxes; for example, when a large bulky holdfast is present.

Specimens dried in the field may later be put in sea water, allowed to straighten out again, and then arranged and dried for permanent storage on sheets of paper. If sea water is not available for floating specimens prior to mounting, fresh water may be used. Many seaweeds do not stick well to paper (the collector must learn by experience which do and which do not). Those which do not can be dried between sheets of newspaper separated by blotters and, when dry, mounted directly on herbarium paper with waterproof glue or gummed-paper strips.

The size of the herbarium sheets generally used is 11½ by 16½ inches for the completed mount, although smaller specimens are usually first mounted on small pieces of paper which are later glued to the larger sheets for filing. The paper should be fairly thick and firm with a high rag content for best results. Plants can also be mounted on notebook-size paper, but the paper should be heavy, otherwise the dried specimen may crack later when the sheet is handled or the page is turned in the notebook. Identification information, such as the serial number should be written on the mounting-paper before the specimen is mounted on it so that the specimen does not become separated from collecting data.

Specimens that are very fine and delicate are usually floated in flat trays, large enough to take the size of paper to be used. A piece of flat metal (such as galvanized iron) or a sheet of glass may be used underneath the paper to raise it out of the water, which should be about one-half inch deep in the tray. The specimen should be arranged or untangled with dissecting needles, forceps, or camel's hair brushes at the same time as the paper is raised. The sheet of mounting-paper is then placed between sheets of blotting paper or extra newsprint, with a sheet of wax paper or thin cotton sheeting, muslin, or cheesecloth between the specimen and the blotting-paper. A number of specimens so arranged are placed in a press and dried slowly. The specimens should be kept under pressure in the press, but not so much as to crush the delicate specimens. Blotters should be changed once in 12 hours or less, and a second time in 24 hours; specimens should be kept in the press until thoroughly dry, changing the blotters occasionally as necessary. An occasional piece of corrugated cardboard placed between blotters in the stack will act as a ventilator and speed the drying process. To speed the drying process further, the press may be placed in the sun (providing the humidity is not too high). A kerosene lantern, heater, or other type of heater may also be used at low heat below a press to speed drying of the specimens. At each change, the waxed paper or cotton should be peeled off gently, changed also or replaced if very wet so that it does not stick permanently to the specimen. With more delicate specimens, the cloth or waxed paper can usually be left in position until the plant is thoroughly dry before peeling it off. The mounted specimens should not be removed permanently from the press until thoroughly dry, otherwise the sheet may curl and the specimen may be damaged or broken. Once dried, the specimens should be stored flat in folders and kept, when not in use, in the dark to preserve their colour. Articulated coralline algæ are very brittle when dried and can best be stored in absorbent cotton in small boxes.

No universal rule for handling all species can be given. The amount of material collected or the number of specimens obtained will undoubtedly vary with the collector. The purpose which the collector has in mind for his material will also determine the best techniques to use for permanent preservation. But if he wishes his collection to have the greatest scientific value, the collector will make careful observations and notes.

The following details are suggested as the ideal information to be obtained. However, it should be emphasized that even when only part of the plant is available, and even if only part of the data can be supplied, the information and fragments of seaweeds may often be helpful in completing an over-all picture of the biolo and distribution in an area.

When possible, plants should be taken in entirety, including t basal attachment region. Sizes should be noted if the plant is lar and only representative portions are collected. When possibl several representative individuals of each kind of plant should collected.

The place, date, and time of collection should be noted in notebook. The place of attachment should be noted with referen to some tide level (upper intertidal, middle intertidal, lower inte tidal, subtidal, or a more precise designation in terms of "feet above or below the tidal reference point). Specimens washed on the beach should not be taken if living attached plants are ava able, but if taken should be noted as "drift." Floating specime should also be ignored (unless of a natural floating habit) whe attached specimens are available. However, as long as proper noted, any of this floating or drift material may be useful ar should not be ignored completely, particularly if it is cast up ju following a storm. Such cast-up material may be in excelle condition and provide the only opportunity of obtaining for otherwise out of reach and difficult to obtain in the area. If spec mens are brought up in nets or trawls, the depth at which they a taken should be noted.

The name of the collector should be noted. A general descri tion of the locality should be noted. The habitat should be describ in greater detail; notations should be made regarding exposure sea, currents, type of substrate — boulders, pebbles, sand, mu barnacles, and so on. Associations should be noted: other alg may be epiphytic or parasitic, or the alga may be commonly ass ciated with various other plants or animals. A photograph of t general locality is often useful.

LIFE HISTORIES

In regard to their life histories, the algæ are among the mo complex and varied of all groups of plants. It is beyond the sco of this handbook to consider the life histories of all the seawee described. But a few of these will be discussed in the next fe

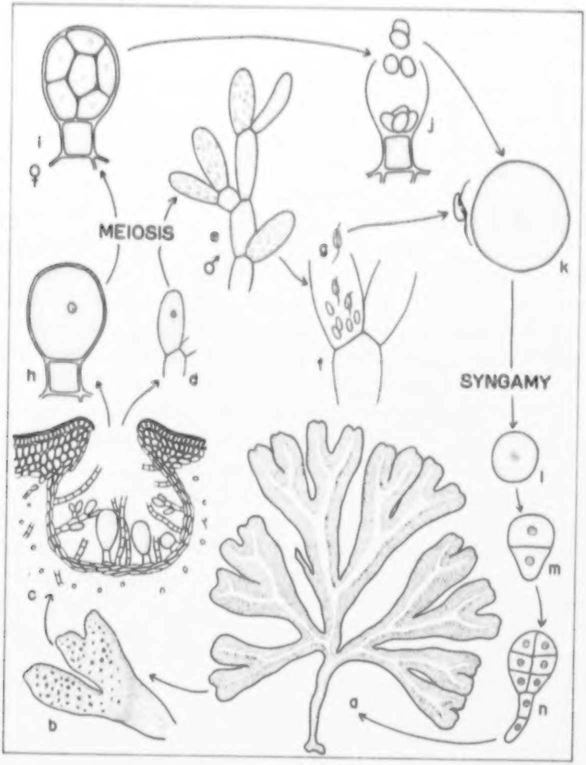


Fig. 1. Life history of *Fucus*. The dichotomously branched, free-living phase (*a*) with branches terminating in swollen receptacles (*b*) produces immersed conceptacles (*c*). Within the conceptacle, oogonia (*h*) and antheridia (*d*) are produced, and meiosis occurs just prior to formation of gametes. As oogonia develop (*i, j*), large non-motile female gametes (eggs) (*j*) are produced and liberated. As antheridia develop (*e, f*), small motile male gametes (sperm) (*g*) are produced and liberated. The gametes (*k*) fuse, and following syngamy the zygote (*l*) undergoes mitotic divisions to produce a multicellular juvenile (*m, n*), eventually resulting in another free-living phase (*a*).

pages to give the reader interested in the biology of the algæ son
appreciation of this aspect of a few representative species of t
different groups.

As in all sexually reproducing organisms, when syngamy (fusio
of gametes) occurs, meiosis (reduction division) must follo
hence there is what is called an alternation of generations in t
life history. But there are a number of modifications or variatio
in this basic theme. At the one extreme, which is illustrated ar
discussed for the rockweed, *Fucus* (Fig. 1) and *Codium* (Fig. 2
the gametes are the only cells of the haploid phase or generatio
and the diploid phase is a conspicuous, usually multicellular fre
living generation. At the other extreme, as is illustrated in *Porphy*
(Fig. 3), the diploid phase is represented by a single cell (t
zygote), which results from a fusion of two gametes, and the ha
loid phase is a conspicuous free-living multicellular generation.

Between these two extremes there are various degrees of elab
ration (or reduction) of the haploid and diploid phases or gener
tions. In *Nereocystis* (Fig. 5), for example, the haploid generati
is a greatly reduced, but still a multicellular generation. Howeve
this haploid phase is nevertheless microscopic and much less co
spicuous than the diploid. Intermediate in this respect is t
situation in *Ulva* (Fig. 4), in which both haploid and diplo
generations are equally conspicuous, and in fact identical in for
In most of the red algæ the life histories are much more complicate
In many, as in *Gracilariopsis* (Fig. 6), the type of life history
somewhat as in *Ulva,* but a second diploid phase occurs betwe
morphologically similar haploid and diploid phases. This seco
diploid generation is diminutive, although multicellular, and
essentially parasitic. It remains attached *in situ* on the female ha
loid generation throughout its existence.

The life histories of the genera used in the above discussion a
discussed briefly and are diagrammatically illustrated in the follo
ing pages. Most of the anatomical and reproductive features sho
are extremely small and can only be observed under the high pow
of the microscope.

In *Fucus* (Fig. 1), the diploid generation, which is the co
spicuous phase at maturity, produces numerous small cavities call

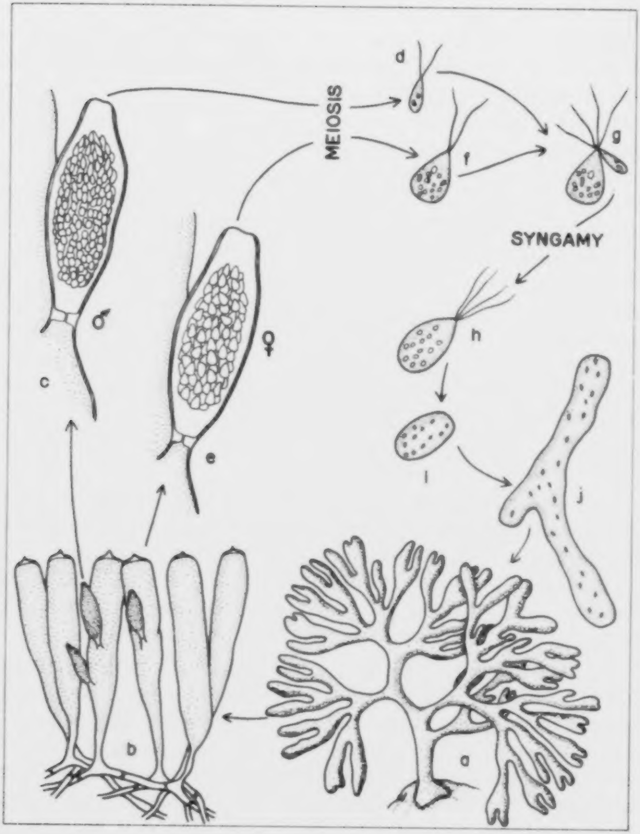


Fig. 2. Life history of *Codium*. The dichotomously branched, free-living phase (*a*) is composed of a spongy mass of filaments which terminate at the surface of the plant in swollen vesicles (*b*). Male (*c*) and female (*e*) gametangia are produced on these vesicles. Meiosis immediately precedes gamete formation. The male (*d*) and female (*f*) gametes are biflagellate and they fuse (*g*, *h*) to form a zygote (*i*), which immediately germinates (*j*), eventually resulting in another free-living phase (*a*).

conceptacles on its swollen branch tips, or receptacles. Inside thes
conceptacles, male and female reproductive organs are produce
At maturity certain cells (gametangia) of the male branches withi
these structures liberate motile, biflagellate male gametes, or sperm
which swim about in the water. Each cell (gametangium) pro
ducing sperm contains a large number of motile sperm, and ther
are many of these sperm-producing cells in each conceptacle. Cer
tain cells (oogonia) on the female branches within these structure
produce non-motile female gametes, or eggs. Each oogonium pro
duces eight eggs in *Fucus*, and there are many oogonia formed i
each conceptacle. When they are liberated at maturity into th
water, each egg is fertilized by a single sperm. The completion o
this process of syngamy (fusion of gametes) results in a diploi
cell, which divides in a well-organized fashion to give rise again t
the typical, conspicuous, free-living generation. In this type of lif
history, meiosis occurs at the time the gametes are produced. Henc
the gametes (eggs and sperm) represent the only haploid phases o
generations in the life history.

In *Codium* (Fig. 2) the life history is very similar to that i
Fucus, except that the male and female gametes are both motile an
biflagellate, although they are markedly different in size. Each o
the gametangia produces a large number of gametes, but becaus
of their smaller size there are more male than female gametes pro
duced in any one fertile cell at maturity.

In *Porphyra* (Fig. 3), the conspicuous multicellular plants a
haploid. The plants are vegetatively rather simple, and almo
every cell of the plant may function as a gamete-producing cell o
gametangium. The male gametangia produce large numbers o
non-motile spermatia, which, when mature, are released into th
water and carried about in currents. However, the female game
tangium produces only one non-motile egg, and it is not release
but remains *in situ*. A spermatium lands on the plant near th
female gametangium and fertilizes the single egg cell within it. Syn
gamy results in the diploid zygote, which, in this case, divides im
mediately by meiosis to produce a large number of spores. Thes
spores, which are called carpospores, germinate and undergo div
sion to produce the haploid sexual generations, thus completing th

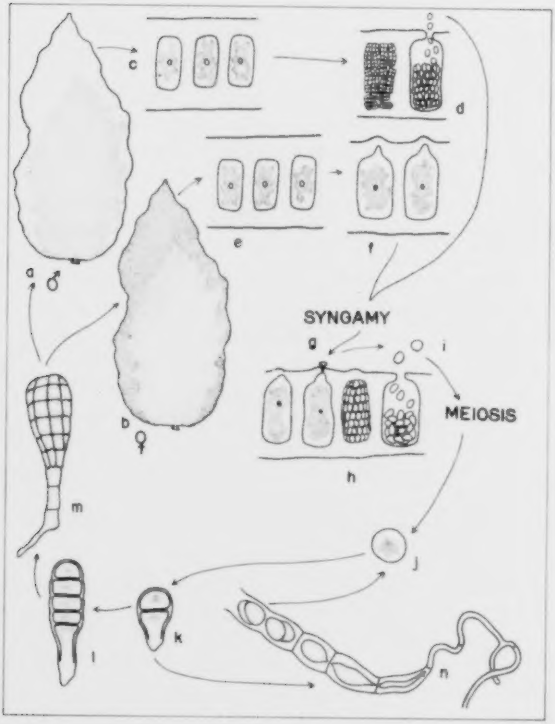


Fig. 3. Life history of *Porphyra*. There are conspicuous male (*a*) and female (*b*) free-living phases which are similar in gross morphology and vegetative structure (*c*, *e*, transverse sections). The vegetative cells metamorphose to give rise to male (*d*) and female (*f*) reproductive organs. The male gamete (*g*) is carried to a receptive region of the female plant (*h*), fertilization occurs, and immediately following syngamy meiosis occurs, resulting in carpospores (*i*). The carpospore (*j*) germinates, and following mitotic divisions (*k*, *l*, *m*) results in another male or female free-living phase. Alternatively, an accessory cycle may occur in which the carpospore germinates to form a filamentous stage (*n*): this in turn produces spores (monospores) which are similar to carpospores in their morphology and potential.

life history. Some further intermediate stages (Fig. 3) may al
occur under certain circumstances, which further complicates t
life history and introduces a possible accessory reproductive cycl

In *Ulva* (Fig 4) haploid and diploid phases are both mult
cellular and are morphologically similar. These plants are ve
simple vegetatively, and almost all cells can function as gametang
on the haploid phases (male and female gametophytic plants) or
spore-producing cells on the diploid phase (sporophytic plant
The gametes are motile and biflagellate and are produced in lar
numbers in each fertile cell. Male and female gametes are morph
logically similar, although they may differ somewhat in size. Th
are both liberated into the water when mature, and fusion of the
gametes (syngamy) results in the first diploid cell (zygote) of t
diploid generation. This zygote undergoes extensive division
produce a multicellular diploid phase (the sporophyte). The fe
tile cells of the diploid plant undergo meiosis and also produ
large numbers of motile structures, which are called zoospor
These swim about briefly, lose the flagella, and settle down on
suitable substrate. The flagella are absorbed and the cell divide
eventually producing a multicellular haploid sexual plant (or gam
tophyte), and thus completing the life history.

In *Nereocystis* (Fig. 5), haploid and diploid phases are bo
multicellular and free living. However, the haploid phase compris
only a few cells; it is a diminutive filamentous sexual generatio
There are separate male and female generations. Certain cells
the male generation produce a single motile sperm. Certain ce
of the female generation produce a single non-motile egg. Wh
mature, the naked egg is extruded into the water, although it remai
sticking to the surface of the cell (oogonium) from which it
liberated. The sperm swims in the water to the egg, and fertilizati
(syngamy) occurs when they fuse. The resulting zygote undergo
extensive cell division, resulting in a juvenile plant which so
becomes markedly differentiated and eventually results in a matur
very complex diploid plant body. Certain cells (sporangia) of th
conspicuous free-living diploid phase produce motile zoospor
following meiosis. When the zoospores are liberated, they swi
about for a brief period, eventually settling down to the substrat

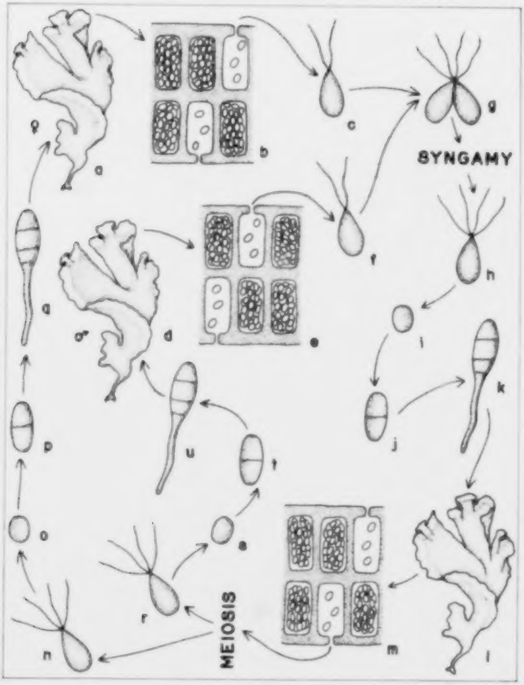


Fig. 4. Life history of *Ulva*. There are conspicuous male (*d*) and female (*a*) free-living phases which are similar in gross morphology and vegetative structure. The vegetative cells metamorphose to give rise to male (*e*, transverse section) and female (*b*, transverse section) gametangia. The male (*f*) and female (*c*) gametes are biflagellate and morphologically similar. They fuse in pairs (*g*) and result in a zygote (*h*, *i*), which divides mitotically, passes through a multicellular juvenile phase (*j*, *k*), eventually resulting in a free-living phase, morphologically similar to the sexual phases. Structurally this plant is also similar to free-living sexual plants. Its vegetative cells metamorphose to give rise to spores (*m*, transverse section), in the process of which meiosis occurs. The zoospores are quadriflagellate (*n*, *r*) and germinate, passing through a juvenile multicellular phase (*s*, *t*, *u*; *o*, *p*, *q*), eventually resulting in another male (*d*) or female (*a*) free-living plant.

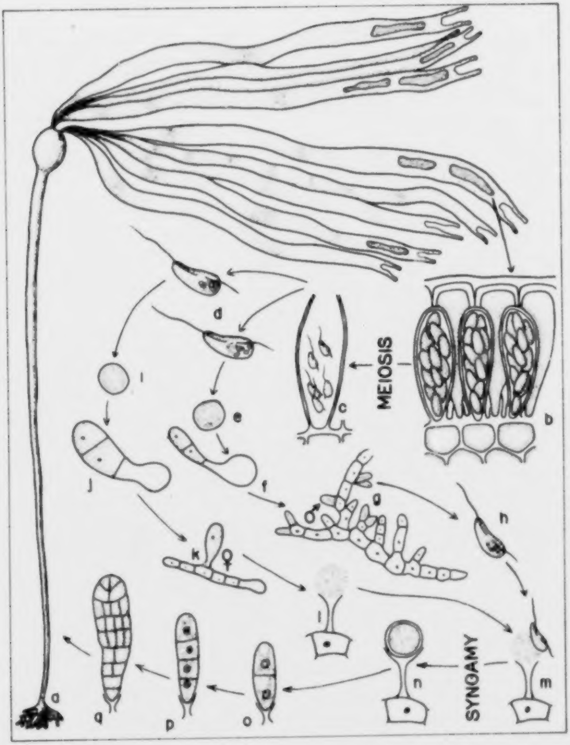


Fig. 5. Life history of *Nereocystis*. The free-living conspicuous phas (*a*) produces dark fertile patches on its strap-like blades. Within these ar produced sporangia (*b*, transverse section), in which meiosis occurs prior t formation of zoospores (*c*). The biflagellate zoospores (*d*) germinat (*e, f; i, j*) to produce diminutive multicellular filamentous sexual plants. Th male plant (*g*) is profusely branched and bears antheridia, each of whic liberates a single biflagellate sperm. The female plant (*k*) bears oogoni each of which produces a single egg (*l*), which is fertilized (*m*) by the motil sperm. Immediately after syngamy the zygote (*n*) divides mitotically an after passing through a multicellular juvenile phase of development (*o, p, q* eventually results in another large free-living conspicuous phase (*a*).

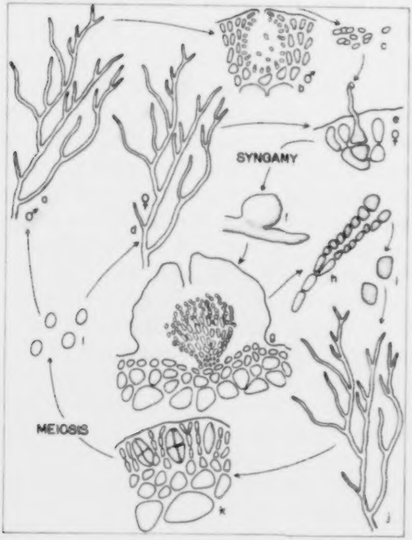


Fig. 6. Life history of *Gracilariopsis*. There are conspicuous male (*a*) and female (*d*) free-living phases which are similar in gross morphology and vegetative construction. Certain superficial cells in these plants metamorphose to produce male (*b*, transverse section) and female (*e*, transverse section) reproductive organs. The male organ, or antheridium (*b*), produces non-motile male gametes (spermatia)(*c*), which are carried by water currents. The female organ, or carpogonium (*e*), produces a non-motile female gamete or egg cell, which is fertilized when a spermatium comes in contact with its emergent receptive process (trichogyne) (*e*). Following syngamy, mitotic cell divisions result in a multicellular, essentially parasitic phase (*g*, transverse section) within the tissue of the female plant. The result of this is a swollen urn-shaped structure (*f*) on the branch of the female plant. Within this urn-shaped structure the developing attached phase produces chains of cells (*h*), some of which liberate non-motile carpospores (*i*). These germinate and develop into a multicellular free-living phase morphologically similar to the sexual free-living plants. At maturity certain superficial cells of this new plant metamorphose into sporangia (*k*, transverse section), in which meiosis occurs. Each sporangium produces four tetraspores (*l*), which germinate to produce another free-living male (*a*) or female (*d*) plant.

where they lose the flagella, divide, and result in the multicellular filamentous free-living male or female generations.

In *Gracilariopsis* (Fig 6) there are haploid and diploid multicellular free-living phases which are morphologically similar. A diminutive additional diploid, parasitic phase develops attached to the female haploid phase. Surface cells in the haploid sexual phases differentiate to produce male and female reproductive organs. Each of the male cells produces only one sperm (usually called a spermatium because it is non-motile). Each of the female cells produces only one egg, which remains attached and is fertilized *in situ* by the non-motile spermatium. The resulting zygote divides to form a multicellular but diminutive parasitic phase. Some cells of this diploid parasitic phase differentiate to form reproductive cells called carpospores, which are liberated into the water. These settle down and grow into free-living diploid plants, morphologically similar to the free-living haploid sexual plants. At maturity another type of spore, which results from meiosis in certain surface cells, is formed on the free-living diploid plant. These spores (tetraspores) germinate to produce the multicellular haploid free-living gamete-producing generations.

STRUCTURE AND REPRODUCTION

In the preceding discussion of life histories of marine algæ, some aspects of reproduction have already been touched upon. In order to become familiar with this aspect of studying seaweeds, the observer must also become familiar with certain structural features of the plants for identification purposes. Gross morphological features may be adequate in some instances to make a positive identification; in others it is not, and details observable under a hand-lens or in some instances under a microscope must be made. Many marine algæ cannot be precisely determined to species or even to genus except after microscopic examination of certain structures. Hence the person interested in this aspect of studying must become adept at making thin sections with a sharp razor blade and familiar with the use of a microscope. In the descriptions and illustrations presented in this guide, as much emphasis as possible has been placed on the use of gross morphological characteristics, where these are sufficient to make a determination. However, where this is inadequate, descriptions and illustrations of representative portions, as can be determined chiefly at the higher magnification obtainable with a good hand-lens, are presented.

Finally, where absolutely necessary, microscopic details have been included, so that a positive identification is possible for all species included in the guide. The keys, too, have been designed, as far as is possible, to incorporate microscopic features only as a last resort. In this way, although one may not in all instances be able to positively identify certain species without reference to microscopic details, the observer will know that the plant he is endeavouring to determine by using the key is one of perhaps two entities. At this point in his deliberation, reference to the detailed descriptions of these entities may be of some further aid in distinguishing the plants and providing him with the correct name.

IDENTIFICATION

At the present time it is not even possible to treat fully the species in such common and relatively conspicuous genera as *Ulva* (Figs. 4, 13) and *Fucus* (Figs. 1, 65) with any degree of confidence, even with the aid of a microscope. Hence these and certain other taxonomically difficult genera are only illustrated by selected species until more detailed monographic studies have been undertaken by specialists and the plants are better known.

On the basis of colour, the attached marine algæ are divided into three classes — Chlorophyceæ (green algæ), Phæophyceæ (brown algæ), and Rhodophyceæ (red algæ). All three classes have the green pigment chlorophyll present. Often it is clearly evident, as in *Ulva* (Figs. 4, 13) and other genera typical of the Chlorophyceæ. But this green colouring material is often masked, either by a brown pigment as in the kelps, such as *Nereocystis* (Figs. 5, 56) and other genera typical of the Phæophyceæ, or by various shades of red and blue, as in some of the so-called sea mosses (Rhodophyceæ), such as *Gracilariopsis* (Figs. 6, 99). However, both reds and browns can be such a dark shade that they are difficult to recognize by their colour alone. Furthermore, the browns and reds can frequently lose their typical colour when growing in bright sunlight, leaving the green pigment more evident. However, such plants are usually not as bright a green as in those genera which lack the masking brown, red, and blue pigments.

Fortunately the fundamental pigment differences usually parallel morphological and anatomical differences unique to each of these main classes of algæ, so that other criteria are often available for distinguishing the different groups of algæ.

Microscopic anatomical detail of tissues and reproductive bodies usually clearly delimit families. However, in the field, characteristics such as shape and size, presence or absence of floats and leaf-like parts, type of branching, and texture are sometimes adequate to distinguish genera and sometimes even species.

SELECTED REFERENCES

COLLINS, F. S. 1913. The marine algæ of Vancouver Island. Victoria Memorial Museum Bulletin No. 1, XIII:99–137.

DOTY, M. S. 1947. The marine algæ of Oregon. Part I: Chlorophyta and Phæophyta. Farlowia, 3(1):1–65, pls. 1–10.

DOTY, M. S. 1947. The marine algæ of Oregon. Part II: Rhodophyta. Farlowia, 3(2):159–215, pls. 11–14.

GUBERLET, M. L. 1956. Seaweeds at ebb tide. University of Washington Press. xvi+182 pp., 86 pls.

HARVEY, W. H. 1862. Notice of a collection of marine algæ made on the north-west coast of North America, chiefly at Vancouver's Island, by David Lyall, Esq., M.D., R.N., in the years 1859–61. Jour. Proc. Linn. Soc., 6:157–176.

HOLLENBERG, G. J., and ABBOTT, I. A. 1966. Supplement to Smith's Marine Algæ of the Monterey Peninsula. Stanford University Press. xii+130 pp., 53 figs.

KYLIN, H. 1925. The marine algæ in the vicinity of the Biological Station at Friday Harbor, Wash. Lunds Univ. Årsskr., N.F. Avd. 2, Bd. 21, Nr. 9; K. Fysiogr., Sållsk. Handl., N.F. Bd. 36, Nr. 9. 87 pp., 47 figs.

SCAGEL, R. F. 1948. An investigation on marine plants near Hardy Bay, British Columbia. No. 1. Prov. Dept. Fish., Queen's Printer, Victoria, B.C. 70 pp., 26 figs., 11 tables.

Scagel, R. F. 1957. An annotated list of the marine algæ of British Columbia and northern Washington. Nat. Mus. Can., Bull. No. 150, Biol. Ser. No. 52. vi+289 pp., 1 fig. Queen's Printer, Ottawa.

Scagel, R. F. 1962. Marine plant resources of British Columbia. Bull. No. 127, Fish. Res. Bd. Can. vii+39 pp., 33 figs., frontisp.

Scagel, R. F. 1966. Marine algæ of British Columbia and northern Washington. Part I: Chlorophyceæ. Bull. 207, Nat. Mus. Can. viii+152 pp., 49 pls. Queen's Printer, Ottawa.

Setchell, W. A., and Gardner, N. L. 1920. The marine algæ of the Pacific Coast of North America. Part II: Chlorophyceæ. Univ. Calif. Publ. Bot., 8(2):139–375, pls. 9–33.

Setchell, W. A., and Gardner, N. L. 1925. The marine algæ of the Pacific Coast of North America. Part III: Melanophyceæ. Univ. Calif. Publ. Bot., 8(3):383–898, pls. 34–107.

Smith, G. M. 1944. Marine algæ of the Monterey Peninsula, California. Stanford University Press. ix+622 pp., 98 pls.

KEYS TO CLASSES OF MARINE PLANTS

PAGE

1. Plants green grass-like, with long narrow leaves of uniform width throughout most of their length; midrib and veins present in leaves; with creeping rhizomes and roots; flowers and seeds produced—Marine Seed Plants 312

1. Plants not grass-like; flowers and seeds not produced—2.

  2. Plants bright green in colour—Chlorophyceæ (green algæ) 36

  2. Plants olive-green, tan or dark brown in colour—Phæophyceæ (brown algæ) 74

  2. Plants reddish, usually rose red but often purplish brown, brownish red, or almost black—Rhodophyceæ (red algæ) 166

CLASS CHLOROPHYCEÆ (GREEN ALGÆ)

There are 29 genera with at least 85 species (including forms and varieties) of green algæ known to occur in this area. Of these, 18 of the more conspicuous genera are described and illustrated in this guide by one species and, in 5 genera, where there are especially varied species, more than one species of the genus has been included. In all, 13 genera with a total of 18 species of green algæ are described and illustrated in the following pages. A key to the genera of green algæ included in this handbook appears below.

KEY TO GENERA OF CHLOROPHYCEÆ (GREEN ALGÆ)

PAGE

1. Plant membranous, one to two cells thick at the margins—2.
1. Plant filamentous, spherical, tubular, rope-like, or feather-like—4.
    2. Plant a minute blade, usually less than 1 cm. tall; one cell thick; attached to rocks high in the inter-tidal zone or above in a splash zone—PRASIOLA 54
    2. Plant more than 1 cm. tall when mature—3.
3. Plant one cell thick—MONOSTROMA 40
3. Plant two cells thick—ULVA 48
    4. Plant spongy, dichotomously branched or cushion-like; composed of masses of narrow, aggregated, branched filaments—CODIUM 68
    4. Plant hollow (spherical or tubular) or composed of an unbranched filament or freely branched filaments—5.
5. Plant hollow—6.
5. Plant filamentous, branched or unbranched—7.
    6. Plant a hollow sphere about 1 cm. or less in diameter—HALICYSTIS 66
    6. Plant a hollow tube, sometimes markedly flattened toward the apex and hollow only along the margins—ENTEROMORPHA 44
7. Plant unbranched—8.
7. Plant branched—11.
    8. Plant a uniseriate filament—9.
    8. Plant a biseriate filament—PERCURSARIA 52
9. Cells small, not visible with the naked eye—10.
9. Cells large, bead-like, visible with the naked eye—UROSPORA 58
    10. Plants short, finely filamentous; cells of filament short, each with a single, band-shaped chloroplast—ULOTHRIX 38
    10. Plants long and stringy, finely filamentous; filaments intertwined and matted in loose strands; cells long and narrow—RHIZOCLONIUM 56

PAGE

11. Plant with feather-like (pinnate) branching—Bryopsis 72

11. Plant irregularly branched with coarse filamentous axes; filaments often densely intertwined—12.

  12. Branches intertwined in dense, branched, rope-like strands—Spongomorpha 64

  12. Branches usually loosely arranged; sometimes short, coarse and tufted—Cladophora 60

ULOTHRIX Kützing

Three poorly demarcated species of the genus *Ulothrix*—*U. flacca* (Dillwyn) Thuret, *U. implexa* Kützing, and *U. lætevirens* (Kützing) Collins—are recorded in British Columbia. They are small filamentous plants, superficially very similar in appearance, forming tufts or mats on various substrates. The species can be distinguished only on microscopic characteristics relating chiefly to chloroplast features. Only one of these species, *Ulothrix lætevirens*, is described and illustrated here.

Ulothrix lætevirens (Kützing) Collins

Description.—The plant occurs in tufts (Fig. 7*a*) or as entangled, creeping, usually unbranched filaments. Filaments may be aggregated at the base to form a compact prostrate mass, almost obscuring the filamentous nature. Cells in the proximal attachment region (Fig. 7*b*) are usually rather irregular in shape and arrangement. The filaments are usually up to 5 cm. in length. The cells at maturity are much shorter than broad (Fig. 7*c*) and each contains a single band-like chloroplast (Fig. 7*d*) almost filling the full length of the cell. Fertile cells (Fig. 7*e*) are only slightly, if at all, swollen and, at maturity, produce a large number of ovoid motile cells (Fig. 7*e*). In the case of zoospores (Fig. 7*f*) motility results from four whip-like flagella.

Habitat.—Attached to rocky surfaces, old wood and other solid substrates, in the intertidal zone.

Pacific Coast Distribution.—Alaska to California.

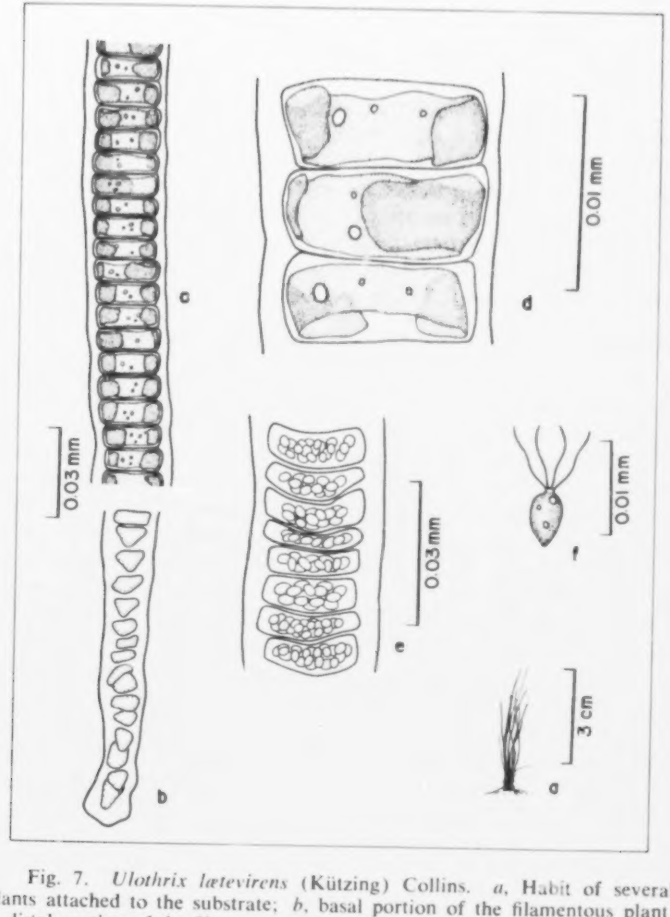


Fig. 7. *Ulothrix lætevirens* (Kützing) Collins. *a*, Habit of several plants attached to the substrate; *b*, basal portion of the filamentous plant; *c*, distal portion of the filamentous plant, showing arrangement of vegetative cells; *d*, enlarged view of a vegetative region of the plant, showing three cells with band-shaped chloroplast; *e*, enlarged view of a fertile portion of the plant, showing cells filled with zoospores; *f*, a quadriflagellate zoospore.

MONOSTROMA Thuret

Five species (and several varieties) of the genus *Monostroma*—*M. arcticum* Wittrock, *M. fuscum* (Postels and Ruprecht) Wittrock, *M. fractum* Jao, *M. oxyspermum* (Kützing) Doty, and *M. zostericola* Tilden—are recorded in British Columbia. They vary considerably in size, shape, and habitat. All of them are broad and flat at maturity and, in transverse sectional view, one cell in thickness. Superficially, some species of the genus are easily confused morphologically with species of the genus *Ulva* (see p. 48), which, in transverse sectional view, is two cells in thickness. Only *M. fuscum* and *M. zostericola* are described and illustrated here.

Monostroma fuscum (Postels and Ruprecht) Wittrock

Description.—The plant develops as a hollow sac in the early stages, but eventually splits open and, at maturity, becomes a broad, flat membranous sheet (Fig. 8*a*) one cell in thickness (Fig. 8*c*), reaching a length of 10–25 cm. and a width of 15–18 cm. The plant is more or less lobed, usually attached by a slightly differentiated cushion-like holdfast of rhizoidal cells. In surface view (Fig. 8*b*) the cells are close-set, have rounded corners (Fig. 8*c*), and are more or less equidimensional. In transverse section (Fig. 8*c*) the cells are elongate, being 3–4 times taller than wide. Although bright green at first, the plant usually becomes darker, and on drying may be olive brown to almost black.

Habitat.—The species is widespread on the Coast, but usually more common in somewhat sheltered regions. It occurs attached to stones, pebbles, and sometimes other algæ in the middle intertidal zone. It is also frequently found floating in brackish water.

Pacific Coast Distribution.—Bering Sea to Washington.

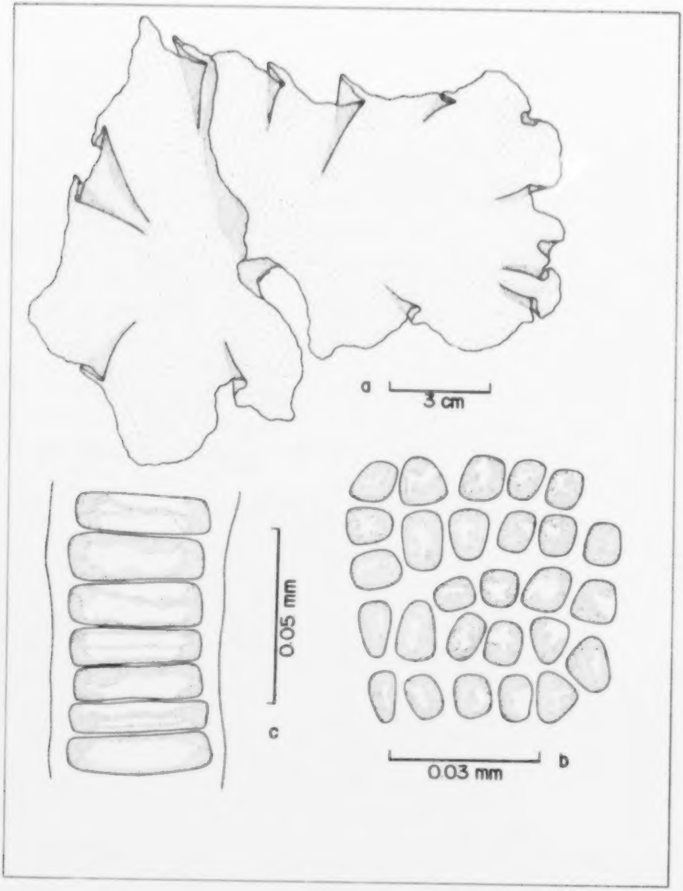


Fig. 8. *Monostroma fuscum* (Postels and Ruprecht) Wittrock. *a*, Habit of plant; *b*, enlarged surface view of plant showing arrangement of vegetative cells; *c*, transverse section of a portion of a plant in distal region showing single-layered arrangement of cells.

Monostroma zostericola Tilden

Description.—The plant develops as a hollow sac in the early stages, but eventually splits open and, at maturity, becomes an irregular, broad, flat, bright green, membranous sheet (Fig. 9*b*) one cell in thickness (Fig. 9*d*). The plants are very fragile, usually collapsing when removed from the water; they are usually present in dense masses aggregated along the margins of the leaves of the marine seed plants *Zostera* and *Phyllospadix* (Fig. 9*a*). The plant is 2–5 cm. high, 1–3 cm. broad, frequently ragged along the margins, attached by a slightly differentiated holdfast of rhizoidal cells. In surface view (Fig. 9*c*) the cells are angular and in more or less distinct rows, and in transverse view (Fig. 9*d*) they are only slightly elongated.

Habitat.—This species is widespread in distribution, occurring in the inner coastal waters as well as along the open coast on leaf margins of the rooted marine seed plants *Zostera* and *Phyllospadix*.

Pacific Coast Distribution.—British Columbia to California.

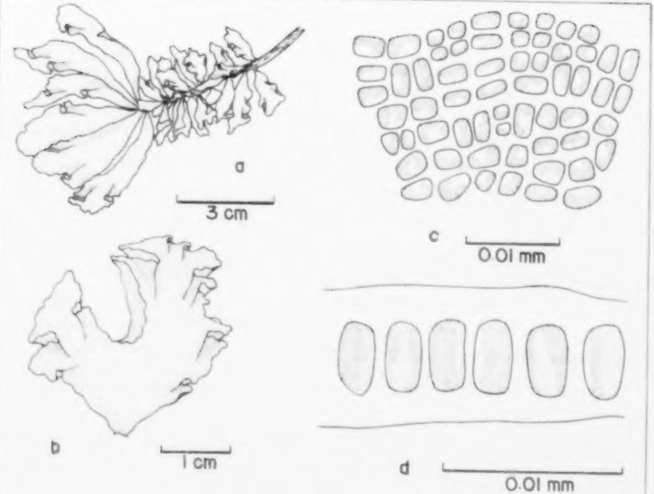


Fig. 9. *Monostroma zostericola* Tilden. *a*, Habit view, showing numerous small plants attached to a portion of a leaf of *Phyllospadix; b*, habit of a complete plant; *c*, enlarged surface view of the distal portion of a plant, showing arrangement of cells; *d*, transverse section of a portion of a plant in the distal region, showing single-layered arrangement of cells.

ENTEROMORPHA Link

Nine species (and several varieties) of the genus *Enteromorpha*—*E. clathrata* (Roth) Greville, *E. compressa* (L.) Greville, *E. crinita* (Roth) J. Agardh, *E. intestinalis* (L.) Link, *E. linza* (L.) J. Agardh, *E. marginata* J. Agardh, *E. prolifera* (Müller) J. Agardh, *E. torta* (Mertens) Reinbold, and *E. tubulosa* Kützing —are recorded in British Columbia. The species vary considerably in size and branching habit, but characteristically they are usually tubular at maturity. Only two species, *E. intestinalis* and *E. linza*, one of which (*E. linza*) is similar in some respects to certain species of *Ulva* (*see* p. 48), are described and illustrated here.

Enteromorpha intestinalis (L.) Link

Description.—The plant is yellowish green in colour, elongate, usually unbranched and tubular, sometimes occurring singly but usually in tufts (Fig. 10*a*) or dense stands. The cylindrical hollow portion (Fig. 10*b*) is often constricted at intervals and tapers toward the base to a narrow stipitate region; it is fastened to the substrate by a slightly diffierentiated holdfast of rhizoidal cells. The plant is usually about 1–20 cm. high, but occasionally may reach a length of a metre; in its broadest diameter the plant is usually about 3–5 mm. in diameter. In transverse section the tubular portion of the plant is one cell thick and the cells are slightly taller than broad; in surface view the cells are more or less equidimensional and in no definite arrangement.

Habitat.—On rocks and epiphytic on other algæ in the upper intertidal zone; often in somewhat brackish water.

Pacific Coast Distribution.—Alaska to Mexico.

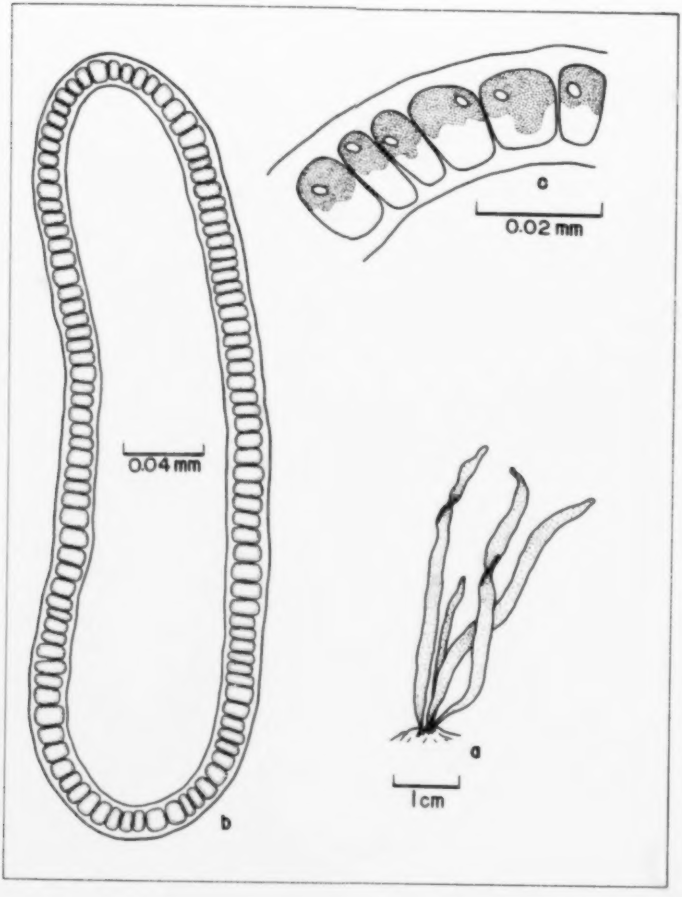


Fig. 10. *Enteromorpha intestinalis* (L.) Link. *a*, Habit view of cluster of plants attached to the substrate; *b*, transverse section of the tubular plant; *c*, transverse section showing a few of the cells making up the wall of the tubular plant.

Enteromorpha *linza* **(L.) J. Agardh**

Description.—The plant is yellowish green in colour, elongate, unbranched, sometimes occuring singly (Fig. 11*a*) but often gregarious. It is flattened distally, sometimes reaching a width of 1–4 cm. or more with ruffled margins, and in the distal flattened region is two cells thick (Fig. 11*c*), being hollow only near the margins of the plant. The plant tapers toward the base to a cylindrical, hollow (Fig. 11*b*) stipitate region and is attached to the substrate by a slightly differentiated holdfast of rhizoidal cells. In surface view, the cells are rectangular to vertically elongate and in no definite arrangement in the distal flattened region; in the tubular, proximal region they are in longitudinal rows. In transverse section the cells are slightly taller than broad (Fig. 11*c*), and in the tubular region the plant is one cell thick (Fig. 11*b*).

Habitat.—On rocks and epiphytic on other algæ in the lower intertidal zone.

Pacific Coast Distribution.—Alaska to Mexico.

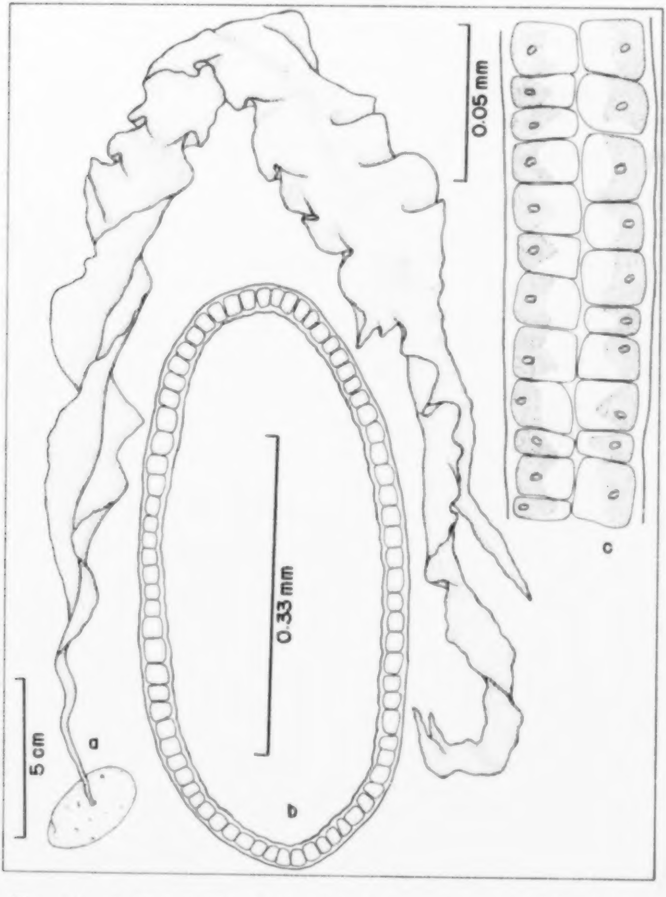


Fig. 11. *Enteromorpha linza* (L.) J. Agardh. *a*, Habit of plant attached to a pebble; *b*, transverse section taken near the base of the plant, showing tubular structure; *c*, transverse section taken from distal portion of plant, showing two-layered arrangement of cells in vegetative condition.

ULVA Thuret

Five species of the genus *Ulva*—*U. expansa* (Setchell) Setchell and Gardner, *U. fenestrata* Postels and Ruprecht, *U. lactuca* L., *U. rigida* C. Agardh, and *U. vexata* Setchell and Gardner—are recorded from British Columbia. Only two of these, *U. fenestrata* and *U. lactuca*, are described and illustrated here.

Ulva fenestrata Postels and Ruprecht

Description.—The plant is yellowish green in colour, elongate, broad and flat, more or less uniformly perforated (Fig. 12*a*), tapering gradually to a slightly differentiated holdfast of rhizoidal cells. The plant is variable in size, usually up to 40 cm. high, but sometimes much larger, especially when free floating. It is two cells in thickness (Fig. 12*b*), and in transverse section the cells are taller than broad. In surface view the cells are more or less equidimensional and in no definite arrangement.

Habitat.—On rocks and free floating in the lower intertidal and upper subtidal zones.

Pacific Coast Distribution.—Alaska to Oregon.

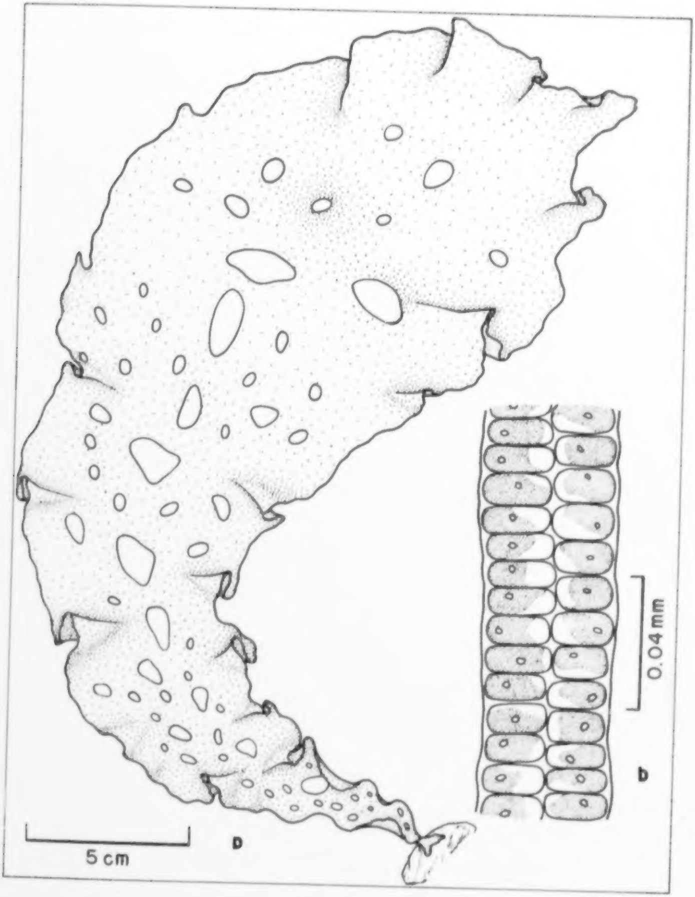


Fig. 12. *Ulva fenestrata* Postels and Ruprecht. *a*, Habit of plant attached to the substrate; *b*, transverse section of the plant in vegetative condition showing two-layered arrangement of cells.

Ulva lactuca L.

Description.—The plant is light to dark green, erect (Fig. 13*a*), lanceolate to broadly ovate, often ruffled along the margins, 18–60 cm. high; at times irregularly split into broad lobes, tapering abruptly near the base to a short stipitate region and a small discoid holdfast of rhizoidal cells. In surface view the cells are irregularly arranged, somewhat angular, and more or less equidimensional. The plant is two cells thick (Fig. 13*b*), and in transverse section the cells are only slightly taller than broad.

Habitat.—On rocks and epiphytic on other algæ in the upper intertidal zone; often floating on mud flats in the lower intertidal zone in quiet bays and lagoons.

Pacific Coast Distribution.—Bering Sea to Chile.

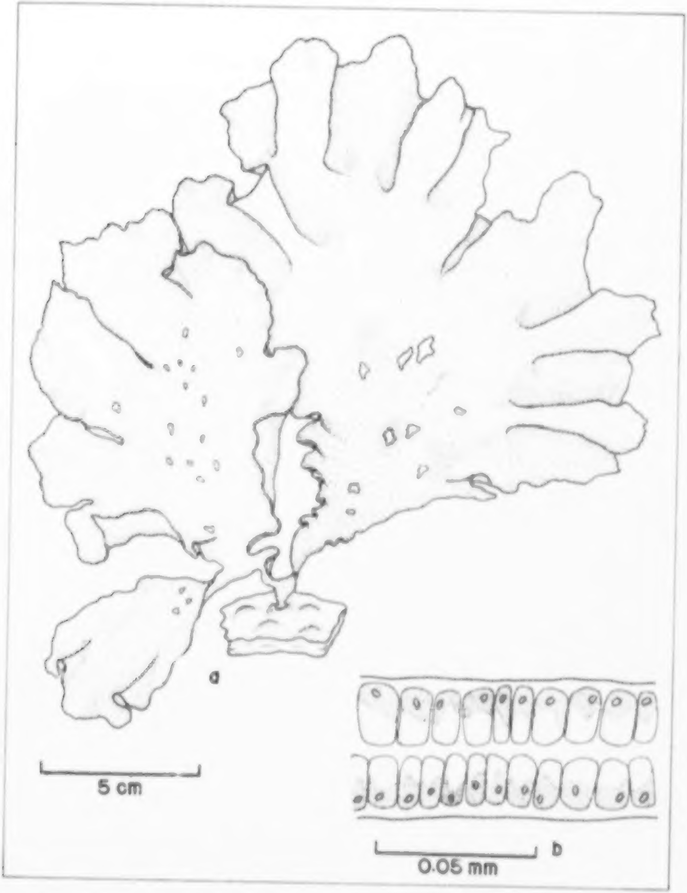


Fig. 13. *Ulva lactuca* L. *a*, Habit of plant attached to substrate; *b*, transverse section of the plant in vegetative condition, showing two-layered arrangement of cells.

PERCURSARIA Bory

There is a single species of this genus in British Columbia.

Percursaria percursa (C. Agardh) Rosenvinge

Description.—The plants are pale green, usually occurring in dense entangled mats (Fig. 14*a*). The plant is usually unbranched, erect, up to 10 cm. high, at first a uniseriate row of cells and remaining so near the base (Fig. 14*c*), above soon becoming biseriate (Fig. 14*d*) with two longitudinal rows of symmetrically placed rectangular cells. The attachment region is a prostrate system of uniseriate rhizoidal branches (Fig. 14*b*), from which one or more erect axes arise.

Habitat.—In brackish pools in the upper intertidal zone and in lagoons.

Pacific Coast Distribution.—Alaska to Chile.

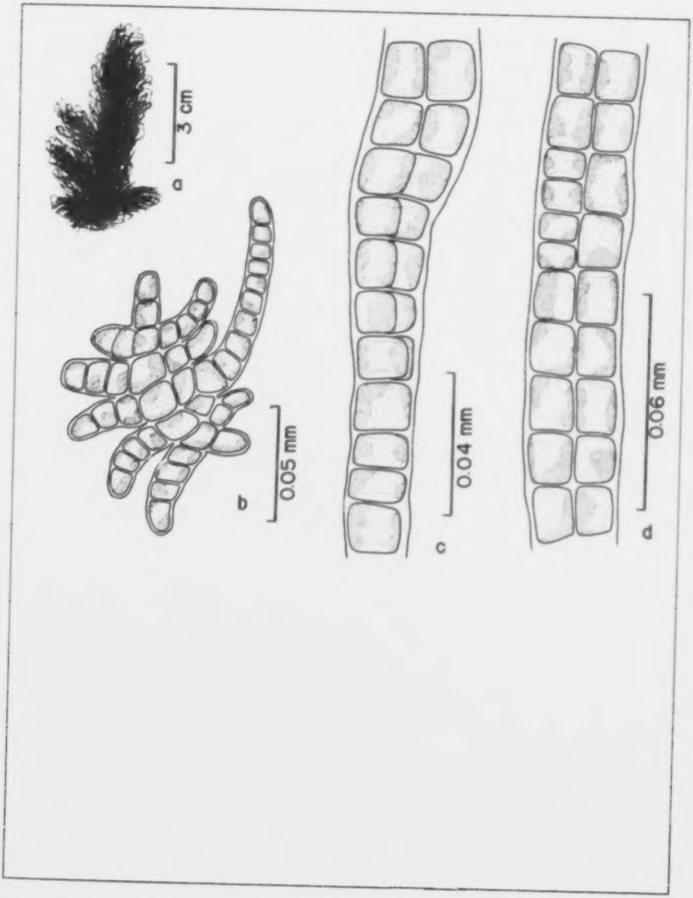

a
3 cm
b
0.05 mm
c
0.04 mm
d
0.06 mm

Fig. 14. *Percursaria percursa* (C. Agardh) Rosenvinge. *a*, Habit of several entangled plants attached to the substrate; *b*, basal prostrate portion of the plant; *c*, portion of erect basal region of plant; *d*, portion of erect distal region of plant.

PRASIOLA (C. Agardh) Meneghini

Only one species of the genus occurs in British Columbia.

Prasiola meridionalis Setchell and Gardner

Description. — The plant is a dirty green colour, generally occurring in dense stands (Fig 15*a*). The mature plant has a short, narrow uniseriate or multiseriate basal region (Fig. 15*c*), but expands rapidly above into a broad flat blade (Fig. 15*b*) one cell in thickness (Fig. 15*f*); at maturity it is up to 1.5 cm. high and 1 cm. broad. In surface view the cells are cubical to round, usually in regular groups (Fig. 15*d*). In transverse section the cells are rectangular and taller than broad. The cells possess a single, distinctive axial, stellate chloroplast (Fig. 15*e*).

Habitat.—In spray zone, just above the intertidal zone, usually on exposed rocks (often bird rocks); occasionally in the upper intertidal zone.

Pacific Coast Distribution.—Alaska to California.

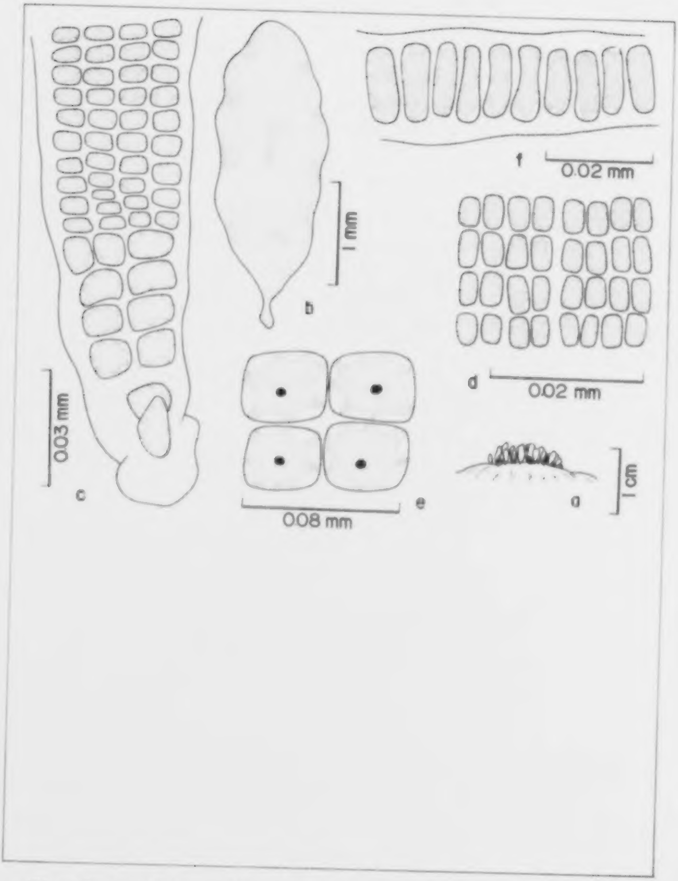

f
0.02 mm
1 mm
b
d
0.02 mm
0.03 mm
c
e
0.08 mm
a
1 cm

Fig. 15. *Prasiola meridionalis* Setchell and Gardner. *a*, Habit of group of plants attached to the substrate; *b*, habit of a single plant; *c*, basal portion of a plant; *d*, surface view of cells in flattened region of plant; *e*, enlarged surface view of four cells, showing star-shaped chloroplast; *f*, transverse section of flattened region of the plant.

RHIZOCLONIUM Kützing

Two poorly demarcated species of the genus *Rhizoclonium*—*R. implexum* (Dillwyn) Kützing and *R. riparium* (Roth) Harvey—are recorded from British Columbia. Only one of these, *R. riparium*, is described and illustrated here.

Rhizoclonium riparium (Roth) Harvey

Description.—The plants form dark-green to pale yellowish-green entangled masses (Fig. 16*a*) of uniseriate filaments (Fig. 16*c*) up to 35 cm. long; sometimes unbranched, or with a few main branches; usually with numerous short tapering, irregular rhizoidal branches (Fig. 16*b*). The cells contain a single, coarsely reticulate chloroplast (Fig. 16*e*).

Habitat.—In skein-like masses on various substrates, including clay banks and entangled with other algæ, in the middle and upper intertidal zones.

Pacific Coast Distribution.—Alaska to Chile.

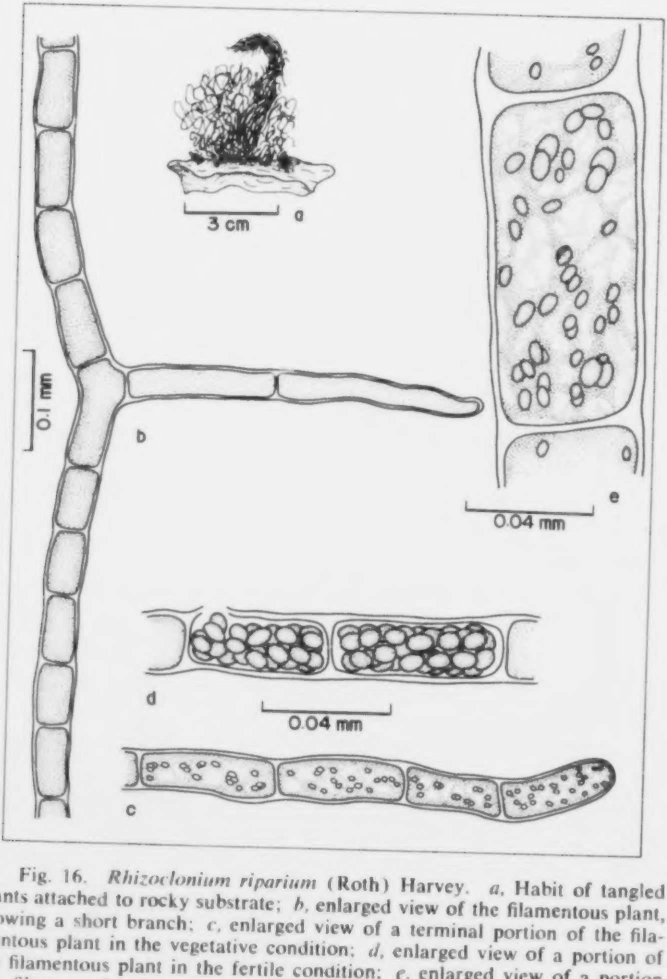


Fig. 16. *Rhizoclonium riparium* (Roth) Harvey. *a*, Habit of tangled plants attached to rocky substrate; *b*, enlarged view of the filamentous plant, showing a short branch; *c*, enlarged view of a terminal portion of the filamentous plant in the vegetative condition; *d*, enlarged view of a portion of the filamentous plant in the fertile condition; *e*, enlarged view of a portion of a filament, showing numerous small discoid chloroplasts present in the cell.

UROSPORA Areschoug

Four poorly demarcated species of the genus *Urospora*—*U. mirabilis* Areschoug, *U. speciosa* (Carmichael) Leblond, *U. vancouveriana* (Tilden) Setchell and Gardner, and *U. wormskjoldii* (Mertens) Rosenvinge—have been recorded from British Columbia. Only one species, *U. mirabilis,* is described and illustrated here.

Urospora mirabilis **Areschoug**

Description.—The plants are dark green in colour, 1–20 cm. tall, generally occurring in dense tufts (Fig. 17*a*) or stands. The plant is an unbranched uniseriate filament (Fig. 17*b*). The attachment region is made up of a number of rhizoidal cells (Fig. 17*b*). The vegetative cells (Fig. 17*c*) are cylindrical or slightly swollen, often as broad as long, and contain a single reticulate or perforate chloroplast (Fig. 17*c*); when the cells are fertile (Fig. 17*d*) they become barrel-shaped, greatly swollen, and, at maturity, liberate unique quardriflagellate zoospores (Fig. 17*e*).

Habitat.—On rocks and old wood in the upper intertidal zone, frequently exposed to surf.

Pacific Coast Distribution.—Bering Sea to Southern California.

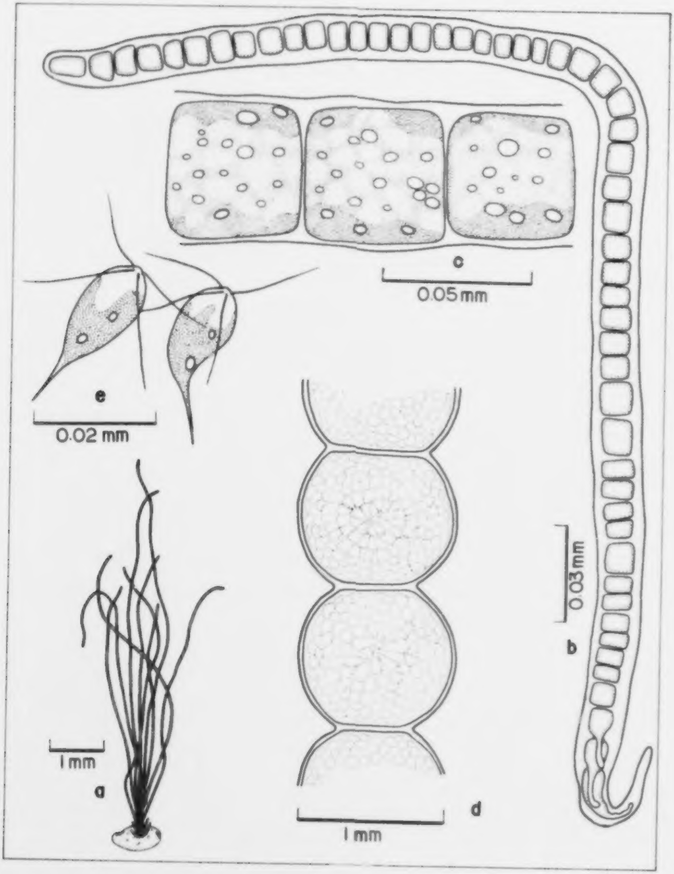


Fig. 17. *Urospora mirabilis* Areschoug. *a*, Habit of several plants attached to the substrate; *b*, a single plant in the vegetative condition; *c*, enlarged view of a vegetative portion of the filament, showing cells with a single reticulate chloroplast; *d*, enlarged view of a fertile portion of the filament, cells filled with zoospores; *e*, quadriflagellate zoospores.

CLADOPHORA Kützing

Nine species of the genus *Cladophora*—*C. albida* (Hudson) Kützing, *C. flexuosa* (Griffiths) Harvey, *C. glaucescens* (Griffiths) Harvey, *C. gracilis* (Griffiths) Kützing, *C. hutchinsiæ* (Dillwyn) Kützing, *C. lætevirens* (Dillwyn) Kützing, *C. microcladioides* Collins, *C. stimpsonii* Harvey, and *C. trichotoma* (C. Agardh) Kützing —are recorded from British Columbia. Some of these are very poorly demarcated, and only two species, *C. flexuosa* and *C. trichotoma*, are described and illustrated here.

Cladophora flexuosa **(Griffiths) Harvey**

Description.—The plant is light green in colour, filamentous, erect, 5–20 cm. high, and profusely branched (Fig. 18*a*). The filamentous branches are uniseriate, with elongate cells, 4–6 times as long as broad (Fig. 18*b*); the cells possess a single, coarsely reticulate chloroplast (Fig. 18*d*). The branches taper at the ends to a subacute apex; the branching habit is alternate or secund, with the ultimate branchlets being only a few cells in length (Fig. 17*b*). The plant is attached to the substrate by means of short, basal, simple or branched rhizoidal filaments (Fig. 18*c*).

Habitat.—In rock pools in the lower intertidal zone.

Pacific Coast Distribution.—Alaska to California.

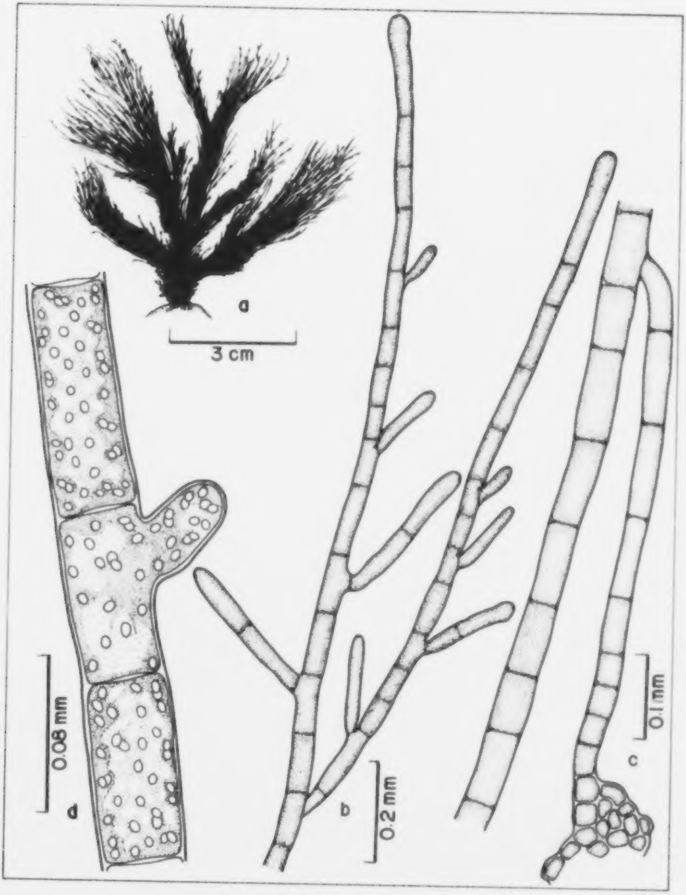


Fig. 18. *Cladophora flexuosa* (Griffiths) Harvey. *a*, Habit of a complete plant attached to a rocky substrate; *b*, enlarged view of distal filamentous branches; *c*, enlarged view of basal filamentous system, showing a rhizoidal branch; *d*, detail of three cells, showing initiation of a young branch.

Cladophora trichotoma (C. Agardh) Kützing

Description.—Plants forming light-green to dark-green hemispherical tufts (Fig. 19*a*) or spongy mats. The plant is a stiff, wiry, branched, uniseriate filament, 2–5 cm. high. The basal system is composed of irregularly branched prostrate filaments; the erect system comprises a few short branches (Fig. 19*b*); branching habit is alternate or rarely opposite. The cells are 2–10 times as long as broad; terminal cells taper slightly to a rounded apex (Fig. 19*c*). The cells possess a single, coarsely reticulate chloroplast (Fig. 19*c*). The plant is attached to the substrate by simple or branched rhizoidal filaments.

Habitat.—On rocks or in pools in the upper intertidal zone, especially in exposed regions of the Coast.

Pacific Coast Distribution.—British Columbia to Mexico.

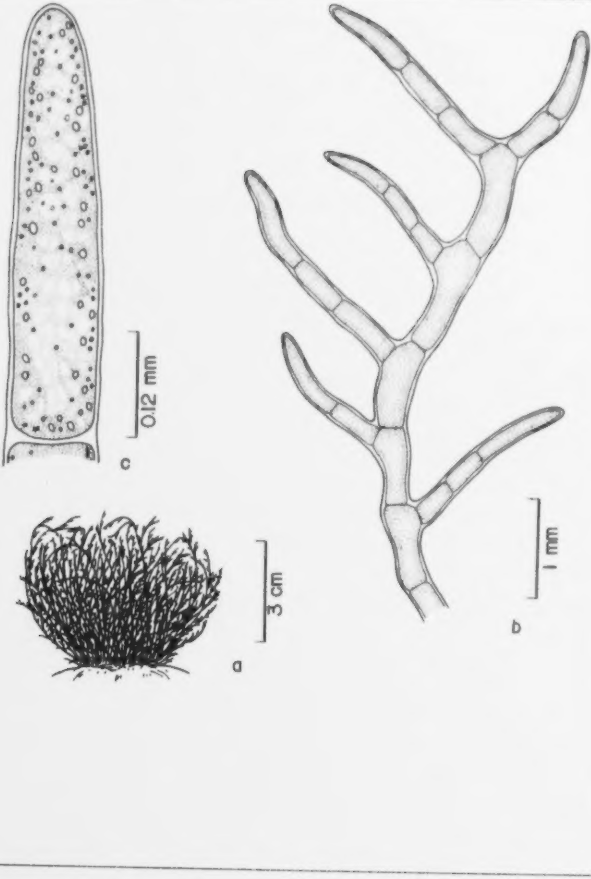


Fig. 19. *Cladophora trichotoma* (C. Agardh) Kützing. *a*, Habit of tufted plants growing attached to a rocky substrate; *b*, enlarged view of a terminal portion of the filamentous plant, showing branching characteristics; *c*, enlarged view of a terminal cell showing detail of reticulate chloroplast.

SPONGOMORPHA Kützing

Five poorly demarcated species of the genus *Spongomorpha*—*S. arcta* (Dillwyn) Kützing, *S. coalita* (Ruprecht) Collins, *S. mertensii* (Ruprecht) Setchell and Gardner, *S. saxatilis* (Ruprecht) Collins, and *S. spinescens* Kützing—are recorded from British Columbia. Only one of these, *S. coalita*, is described and illustrated here.

Spongomorpha coalita (Ruprecht) Collins

Description. — The plant is at first bright green and loosely tufted, soon forming dense rope-like axes (Fig. 20*a*) of entangled, uniseriate, branched filaments, up to 30 cm. high (Fig. 20*b*). The filaments are dichotomously branched in the lower region of the plant, becoming irregularly alternate or unilateral in the upper region. The main axes terminate in a blunt elongate apical cell; lesser orders terminate in an acute apical cell. Short determinate, curved, or hook-like branches (Fig. 20*c*) occur, especially near the base, in the rope-like portion of the axes. The plant is attached to the substrate by means of simple or branched rhizoidal filaments. The cells possess a single coarsely reticulate chloroplast.

Habitat.—On rocks and epiphytic on other algæ in the middle and lower intertidal zones.

Pacific Coast Distribution.—Alaska to California.

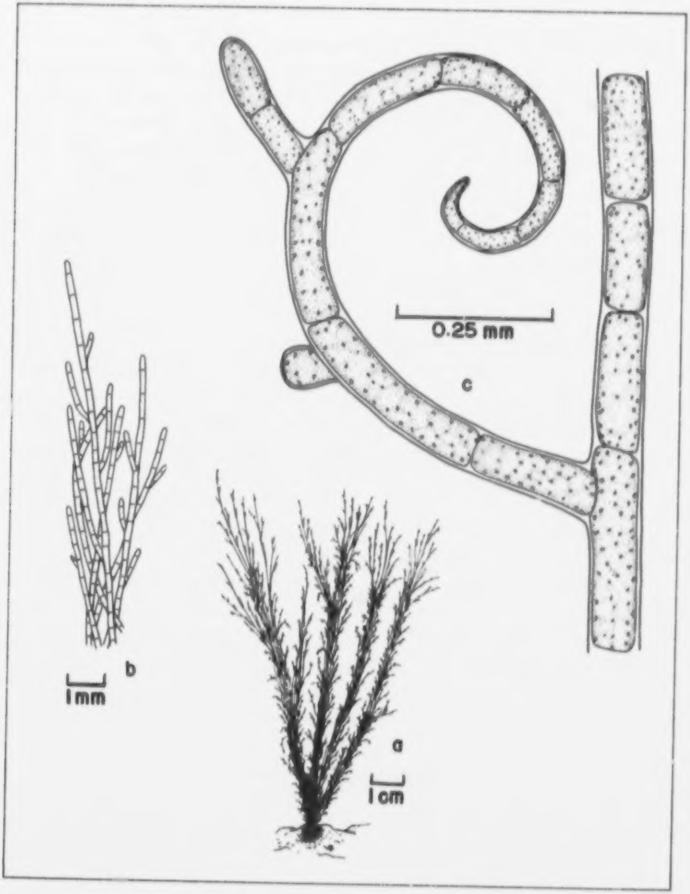


Fig. 20. *Spongomorpha coalita* (Ruprecht) Collins. *a*, Habit of plant attached to rocky substrate; *b*, distal portion of plant, showing branched filamentous organization; *c*, enlarged view showing characteristic curved branchlets responsible for the rope-like strands of the macroscopic branched system.

HALICYSTIS Areschoug

There is only one species of the genus *Halicystis* recorded in British Columbia. The life history of this genus is unusual in having markedly different (morphologically) haploid and diploid phases. The haploid, or *Halicystis*-stage (Fig. 21*a*), is a saccate plant, whereas the diploid, or *Derbesia*-stage, is a branched filament (Fig. 21*c*, *d*).

Halicystis ovalis **(Lyngbye) Areschoug**

Description.—The *Halicystis*-stage, or gamete-producing phase, is an erect dirty-green globose plant up to 1 cm. in diameter, which has a short terete stalk and is attached to the substrate by a prostrate system of colourless rhizoidal filaments. The plant becomes fertile during low-tide periods (about every 14 days) and produces conspicuous gametangial regions (Fig. 21*b*) of distinctive colour and conspicuous colourless discharge pores. The male plant produces brownish-green gametangial regions; the female plant produces dark-green to almost black gametangial regions. The *Derbesia*-stage, which develops from the zygote following fusion of gametes (syngamy), is a profusely branched, spore-producing filamentous phase (Fig 21*c*). The filaments are bright green, erect, 1–4 cm. high, occurring in erect tufts. The structure of the filaments is somewhat unique in being mostly non-septate (having few cross-walls) (Fig. 21*d*). The filament contains large numbers of small discoid chloroplasts. The filaments are attached to the substrate by means of an irregularly branched system of protrate rhizoidal filaments with lobed root-like extensions (Fig. 21*e*). At maturity large ovoid sporangia are formed on the filaments (Fig. 21*f*, *g*).

Habitat.—The *Derbesia*-stage grows on rocks, sponges, and is epiphytic on articulated and encrusting coralline algæ in the lowermost intertidal zone and in the subtidal zone to a depth of several fathoms. The *Halicystis*-stage is epiphytic on encrusting coralline algæ in rocky regions in the lowermost intertidal zone on the open coast, and subtidally to a depth of several fathoms in both exposed and somewhat sheltered regions of the Coast.

Pacific Coast Distribution. — *Derbesia*-stage, Alaska to California; *Halicystis*-stage, Alaska to Mexico.

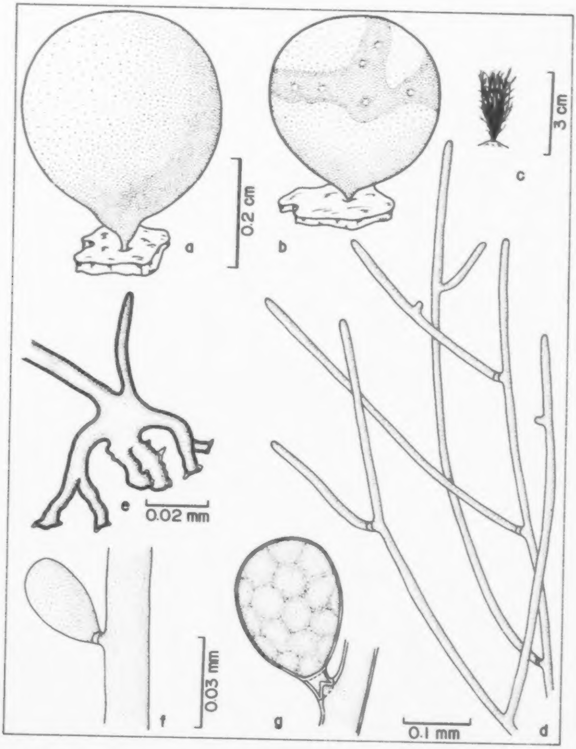


Fig. 21. *Halicystis ovalis* (Lyngbye) Areschoug. *a*, Habit of saccate plant (*Halicystis*-stage) in vegetative condition attached to substrate; *b*, habit of saccate plant (*Halicystis*-stage) in fertile condition, showing dark gametangial regions with discharge pores, attached to the substrate; *c*, habit of filamentous plant (*Derbesia*-stage) attached to rocky substrate; *d*, enlarged view of a distal portion of the branched filamentous plant (*Derbesia*-stage) in sterile condition; *e*, enlarged view of the basal portion of the filamentous plant (*Derbesia*-stage) showing rhizoidal attachment region; *f*, enlarged view of a fertile branch of the filamentous plant (*Derbesia*-stage) with swollen young sporangium; *g*, enlarged view of a fertile branch of the filamentous plant (*Derbesia*-stage) with a mature sporangium.

CODIUM Stackhouse

Two species of the genus *Codium*—*C. fragile* (Suringar) Hariot and *C. setchellii* Setchell and Gardner—are recorded from British Columbia; a third species, *C. ritteri* Setchell and Gardner, occurs in Alaska, and may eventually be found in British Columbia. Two of these species, *C. fragile* and *C. setchellii,* are described and illustrated here.

Codium fragile (Suringar) Hariot

Description.—The plant (Fig. 22*a*) is dark green in colour, erect, up to 40 cm. high, dichotomously branched, with several orders of cylindrical branches, 3–10 mm. in diameter. It arises from a broad, spongy basal disk. The branches are composed of densely compacted, chiefly non-septate, medullary filaments which terminate at the surface in swollen vesicles with spine-like apices (Fig. 22*b*). At maturity, conspicuous gametangia are produced laterally on these vesicles (Fig. 22*b*).

Habitat.—Growing attached to rocks in the middle and lower intertidal zones and the upper subtidal zone; common in large tide-pools.

Pacific Coast Distribution.—Alaska to Mexico.

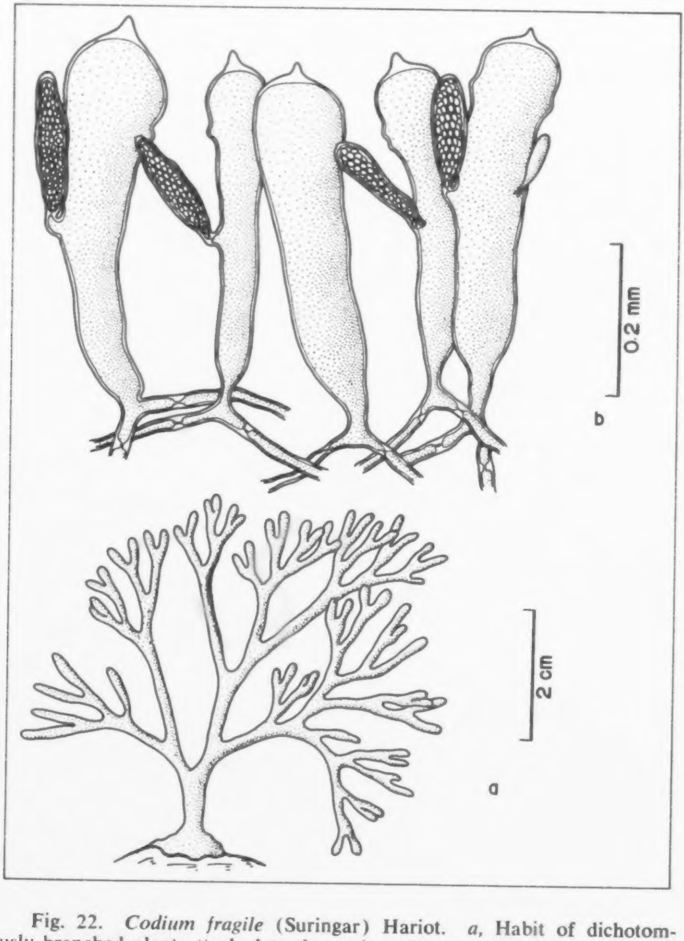


Fig. 22. *Codium fragile* (Suringar) Hariot. *a*, Habit of dichotomously branched plant attached to the rocky substrate; *b*, enlarged view (in transverse section) of surface region of the plant, showing filamentous structure of the plant, swollen terminal vesicles, and gametangia.

Codium setchellii **Setchell and Gardner**

Description.—When young, the plant is in the form of a small flat cushion. The mature plant is in the form of a dark-green, extensive, spongy encrusting layer, 5–15 mm. thick, irregular in outline, and adhering closely to the substrate (Fig. 23*a, b*). The plant body is composed of an extensive medullary system of intertwined, chiefly non-septate filaments; the filaments terminate at the surface in swollen vesicles with somewhat flattened apices (Fig. 23*c*).

Habitat.—On rocks in the lower intertidal and upper subtidal zones.

Pacific Coast Distribution.—Alaska to Mexico.

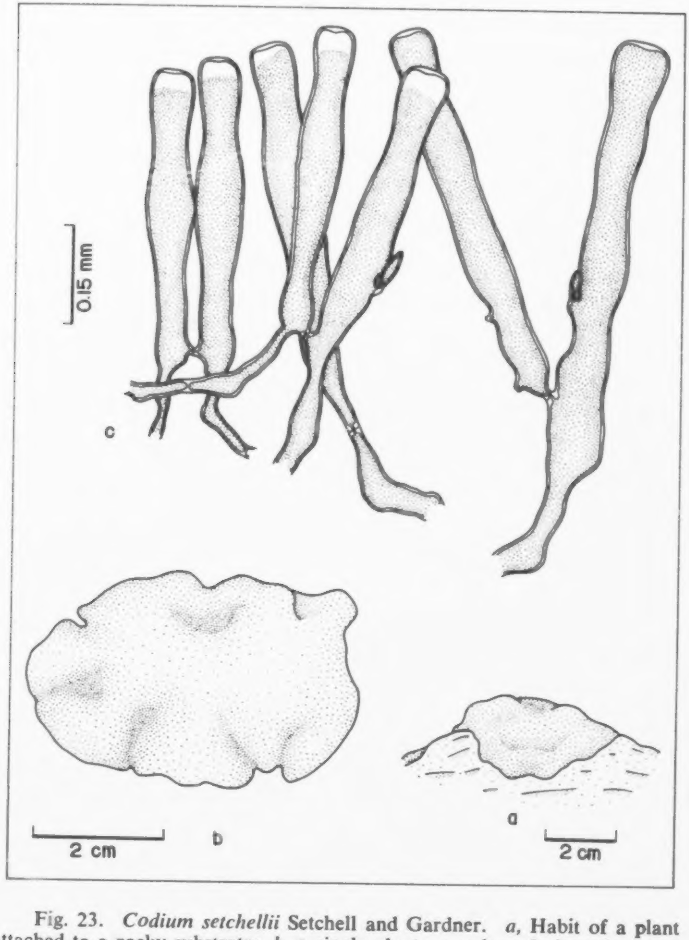


Fig. 23. *Codium setchellii* Setchell and Gardner. *a,* Habit of a plant attached to a rocky substrate; *b,* a single plant; *c,* enlarged view (in transverse section) of surface region of the plant, showing filamentous structure of the plant with swollen terminal vesicles.

BRYOPSIS Lamouroux

Two species of the genus *Bryopsis*—*B. corticulans* Setchell and *B. plumosa* (Hudson) C. Agardh—are recorded from British Columbia. One of these, *B. corticulans,* is described and illustrated here.

Bryopsis corticulans Setchell

The plants are dark green, gregarious, up to 14 cm. high, with erect pinnately branched axes (Fig 24*a*), and are fastened to the substrate by a system of irregularly branched rhizoids. The plant is composed of chiefly non-septate branches with a percurrent axis up to 1 mm. in diameter. Successive orders of branches are smaller, with alternate branchlets determinate, decreasing in length toward the apex (Fig. 24*b*). The branches are abruptly rounded at the point of attachment on the main axes (Fig 24*c*). Short ultimate branchlets metamorphose to produce gametangia (Fig. 24*d*), from which biflagellate gametes (Fig. 24*e*) are released at maturity.

Habitat.—On rocks, shell, and old wood in the lower intertidal zone.

Pacific Coast Distribution.—British Columbia to Mexico.

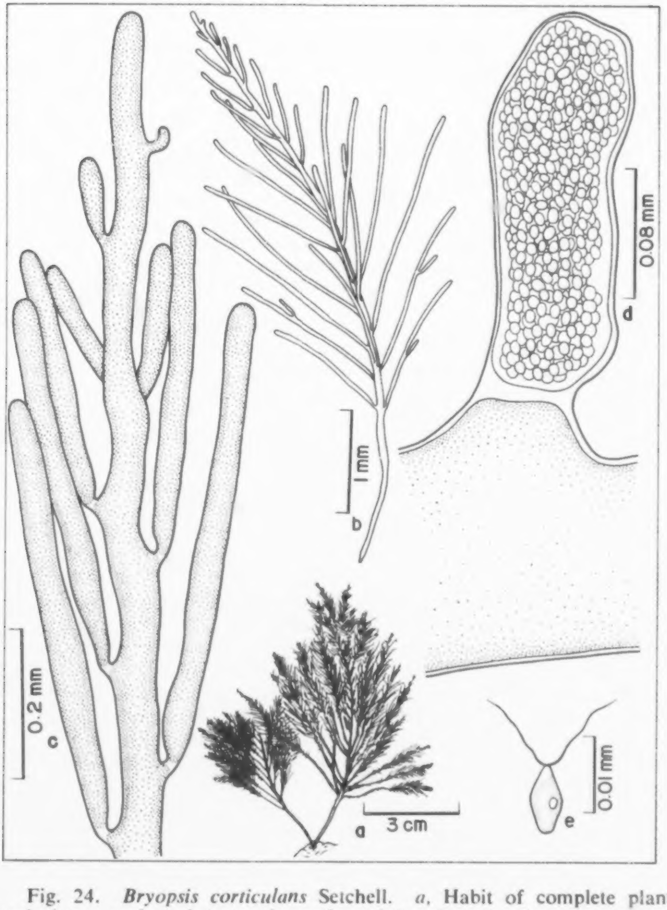


Fig. 24. ***Bryopsis corticulans*** Setchell. *a*, Habit of complete plant attached to a rocky substrate; *b*, portion of the plant showing arrangement of branchlets; *c*, enlarged view of the apical portion of a branch showing vegetative branchlets; *d*, enlarged view of a fertile branchlet (gametangium) filled with gametes; *e*, biflagellate gamete.

CLASS PHÆOPHYCEÆ (BROWN ALGÆ)

There are 46 genera with at least 131 species (including forms and varieties) of brown algæ known to occur in British Columbia. Of these, 28 of the more conspicuous genera are described and illustrated in this guide by one species, and six by more than one species where there are especially varied species. In all, 34 genera of brown algæ with a total of 44 species are described and illustrated in the following pages. A key to the genera of brown algæ included in this guide appears below.

KEY TO GENERA OF PHÆOPHYCEÆ (BROWN ALGÆ)

PAGE

1. Plant with a long tapered cylindrical stipe, solid below and fastened to the substrate by a profusely branched holdfast, hollow above and terminating in a large float from which numerous long flat blades arise—NEREOCYSTIS 140

1. Plant not as above—2.

2. Plant forming a flat, tightly adherent encrusting layer on rock surfaces; comprising erect, laterally adherent uniseriate filaments—RALFSIA 82

2. Plant not as above—3.

3. Plant a uniseriate, usually branched filament; branches free from one another—4.

3. Plant not as above—5.

4. Branching usually irregular and profuse; gametangia and sporangia terminally situated on short branchlets—ECTOCARPUS 80

4. Branching, if any, usually infrequent; gametangia and sporangia intercalary in position in the filament—PYLAIELLA 78

5. Plant repeatedly pinnately branched, with orders of branching progressively longer from apex to base; branches terminate in a conspicuous, elongate, apical cell; uniseriate at first, becoming multiseriate a short distance from apices; with cells in regular transverse rows—SPHACELARIA 84

5. Plants not as above—6.

6. Plant with one or more solid, cylindrical, erect axes arising from a conspicuous basal disk; profuse unbranched branchlets, all approximately the same length, arising radially from the percurrent erect axis—HETEROCHORDARIA 90

6. Plant not as above—7.

7. Plant with one or more cylindrical, erect, tubular (hollow) unbranched axes arising from a small basal disk; sometimes markedly constricted at intervals—SCYTOSIPHON 106

PAGE

7. Plant not as above—8.
    8. Plant spherical to irregular, prostrate, spongy, usually deeply convoluted and hollow when mature; often epiphytic on various other algæ—LEATHESIA 86
    8. Plant not as above—9.
9. Plant spherical, globose, ovoid, or elongate; hollow—10.
9. Plant not as above—11.
    10. Plant with dark spots (sori) when mature; usually epiphytic on *Odonthalia* and *Rhodomela*—SORANTHERA 104
    10. Plant without conspicuous dark spots (sori) at maturity—12.
11. Plant regularly dichotomously branched, predominantly flat throughout except near the base, with or without conspicuous midrib; with swollen tips at maturity—14.
11. Plant not as above—13.
    12. Plant more or less globose, usually irregular and firm at maturity; usually epiphytic on *Odonthalia*—COLPOMENIA 112
    12. Plant ovoid to elongate, sometimes irregular; thin and collapsed when not in water; on rocks or epiphytic on *Cystoseria*—COILODESME 114
13. Plant broadly flattened or blade-like in part or throughout; branched or unbranched—18.
13. Plant mostly erect, cylindrical throughout, or only slightly flattened (sometimes with differentiated flattened basal branches)—15.
    14. Plant, when mature, less than 15 cm. high, branches usually less than 0.5 cm. wide; found only on exposed coast, high in the intertidal region—PELVETIOPSIS 160
    14. Plant, when mature, usually more than 15 cm. high; branches in flattened region of plant usually more than 0.5 cm. wide—FUCUS 158
15. Plant with numerous small spherical floats—16.
15. Plant without small spherical floats—17.
    16. Floats spherical, produced single, apiculate—SARGASSUM 164
    16. Floats spherical, produced in short chains—CYSTOSEIRA 162
17. Branches produced irregularly; plant with radial to percurrent axis; soft and slimy to touch—HAPLOGLOIA 88
17. Branches opposite or alternate, not slimy to touch, usually coarse and wiry—DESMARESTIA 92
    18. Plant generally small, unbranched, without a definite stipe or a root-like holdfast—19.
    18. Plant not as above—21.
19. Plant linear (often laciniate), tapering gradually at base to conspicuous discoid holdfast; polystromatic, with elongated thick-walled medullary cells merging into smaller cells toward the surface; fastened to rocks, often partially buried in sand—PHÆOSTROPHION 118

PAGE

19. Plant not as above—20.

20. With four to six layers of cells, those of two middle layers larger than the cortical cells—PUNCTARIA 102

20. Medulla of several layers of large thin-walled cells; cortex of small cells—PETALONIA 110

21. Plant attached by small discoid holdfast, terete near the base, flattened and linear above; branched from margins, with percurrent midrib and anastomosing veins throughout—DESMARESTIA 92

21. Plant generally large with a definite holdfast, blade, and usually a stout stipe—22.

22. Plant with a single sessile or stipitate blade—23.

22. Plant not as above—29.

23. Blade with five or seven percurrent midribs; holdfast profusely branched and root-like—COSTARIA 130

23. Blade not as above—24.

24. Blade with three to five percurrent folds; holdfast discoid—CYMATHERE 128

24. Plant not as above—25.

25. Plant without a conspicuous stipe at maturity, with root-like structures making up holdfast arising from base of blade; blade irregularly furled, smooth or densely bullate—HEDOPHYLLUM 136

25. Plant with a conspicuous stipe—26.

26. Blade without midrib (although sometimes with a median smooth differentiated region) and without perforations—28.

26. Plant not as above—27.

27. Midrib broad and smooth, blade wrinkled where it joins midrib; plant without sporophylls—PLEUROPHYCUS 126

27. Midrib narrow; plant with sporophylls arising on opposite sides of stipe—ALARIA 150

28. Plant with perforations, sometimes with a dentate margin; blade smooth or finely bullate, with median longitudinal smooth differentiated region—AGARUM 132

28. Blade without perforations; smooth or bullate—LAMINARIA...... 120

29. With several erect stipitate blades arising from a prostrate rhizome-like holdfast; blade with conspicuous ridges forming reticulum—DICTYONEURUM 138

29. Plant not as above—30.

30. Plant bearing numerous floats—31.

30. Plant without floats—32.

31. Plant profusely branched from base, with long terete stipes bearing blade-like branches unilaterally; surface of blades deeply furrowed; each blade with a basal spherical to oval float at point of attachment—MACROCYSTIS 144

PAGE

31. Blades short, numerous, arising in two opposite rows along narrow strap-like branches, often replaced by spherical to oval floats—EGREGIA 156
    32. Stipe undivided and bearing many blades at apex; blades densely furrowed—POSTELSIA 142
    32. Plant not as above—33.
33. Stipe dichotomously divided and each final dichotomy with a single blade—34.
33. Plant with long stout woody stipe, terminal flat blade, and cluster of longer laterals along two sides of flattened upper portion of stipe—PTERYGOPHORA 148
    34. Surface and margins of blades smooth—LESSONIOPSIS 146
    34. Blades densely furrowed, with dentate margins—EISENIA 154

PYLAIELLA Bory

Three species of *Pylaiella—P. littoralis* (Lyngbye) Kjellman, *P. tenella* Setchell and Gardner, and *P. washingtoniensis* Jao—are described from British Columbia. Only the most common species, *P. littoralis,* is described and illustrated here.

Pylaiella littoralis **(Lyngbye) Kjellman**

Description.—The plants are filamentous, 5–15 cm. tall, with uniseriate axes (Fig 25*b*) having cells 1–6 times as long as broad; branching opposite or alternate; filaments twisted into rope-like strands (Fig. 25*a*); forming yellowish-brown to dark-brown mats. The cells possess numerous discoid chloroplasts (Fig. 25*c*). Sporangia and gametangia occur intercalary in catenate series of 5–15 barrel-shaped cells, somewhat broader than vegetative cells, and subdivided into smaller units (Fig. 25*d*).

Habitat.—On rocks, wood, and epiphytic on other algæ in the middle and lower intertidal zones.

Pacific Coast Distribution.—Bering Sea to California.

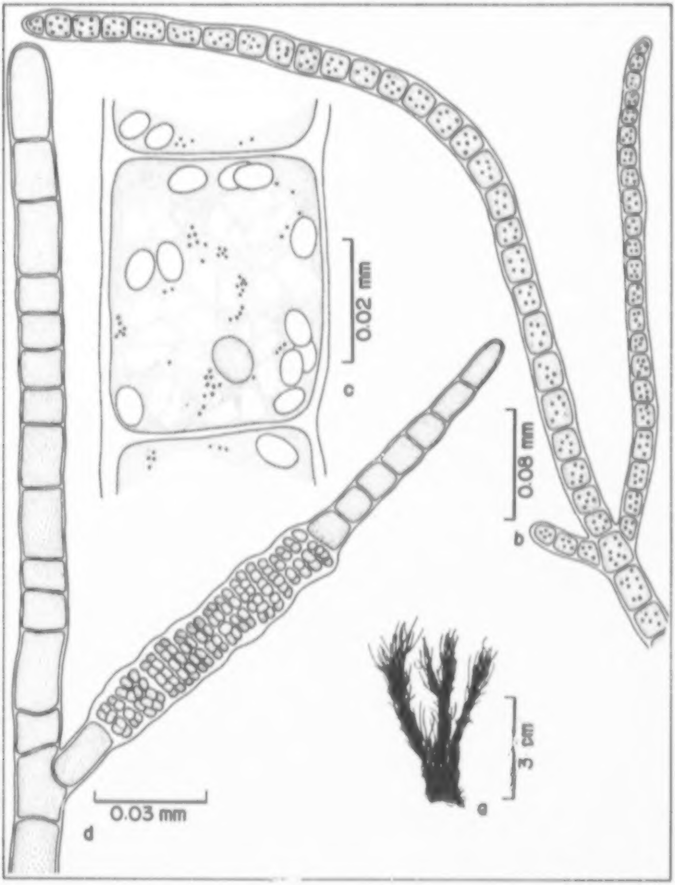


Fig. 25. *Pylaiella littoralis* (Lyngbye) Kjellman. *a*, Habit of plant, showing tufted characteristic of intertwined filaments; *b*, distal portion of filamentous axis; *c*, portion of filament showing cell detail at high magnification; *d*, portion of filament showing branch with intercalary reproductive plurilocular organs.

ECTOCARPUS Lyngbye

Eleven species (and one variety) in the genus *Ectocarpus*—*E. acutus* Setchell and Gardner, *E. confervoides* (Roth) LeJolis, *E. corticulatus* Saunders, *E. cylindricus* Saunders, *E. dimorphus* Silva, *E. granulosus* (J. E. Smith) C. Agardh, *E. mucronatus* Saunders, *E. oviger* Harvey, *E. pygmæus* Areschoug, *E. terminalis* Kützing, and *E. tomentosus* (Hudson) Lyngbye — are recorded from British Columbia. Only one of these, *E. dimorphus,* is described and illustrated here.

Ectocarpus dimorphus Silva

Description.—Plants grow epiphytically in tufts (Fig. 26*a*), up to 2 cm. high, generally on mature portions of larger brown algæ. Uniseriate filaments (Fig. 26*b*) are sparingly branched, with branching predominantly alternate and with cells 1–3 times as long as broad. Chloroplasts are large, band-shaped, and there are several to a cell (Fig. 26*c*). Sporangia of two types (Fig. 26*e*, uniseriate; Fig. 26*d*, multiseriate) are produced on short branchlets.

Habitat.—Epiphytic on larger brown algæ, particularly members of the Laminariales.

Pacific Coast Distribution.—British Columbia to Mexico.

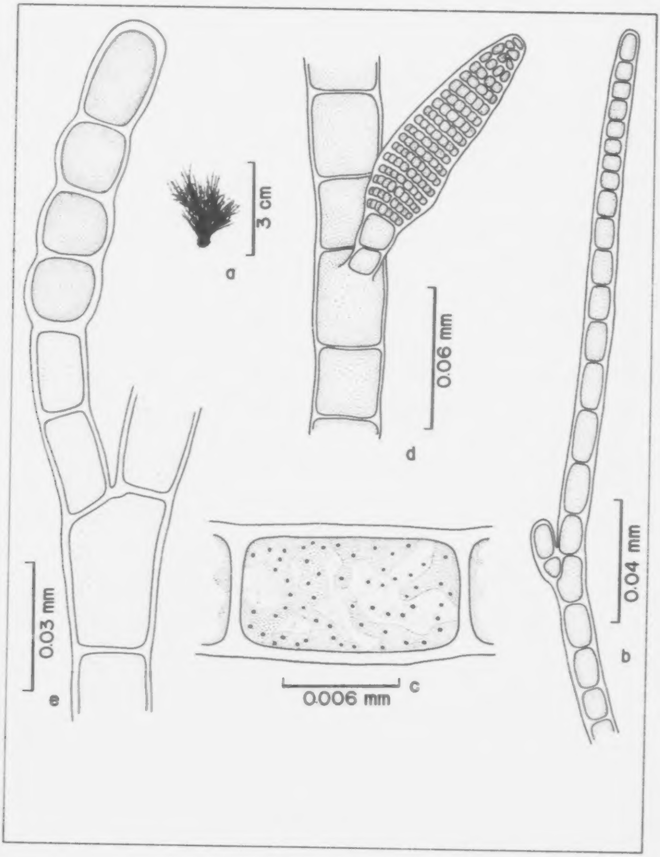


Fig. 26. *Ectocarpus dimorphus* Silva. *a,* Habit of plant, showing tufted characteristic of intertwined filaments; *b,* distal portion of filamentous axis showing vegetative cells; *c,* single vegetative cell, showing detail at high magnification; *d,* portion of filament showing plurilocular reproductive organ; *e,* portion of filament showing swollen cells of uniseriate sporangium.

RALFSIA Berkeley

Two species of the genus *Ralfsia*—*R. fungiformis* (Gunnerus) Setchell and Gardner and *R. pacifica* Hollenberg—are recorded from British Columbia. Only one of these, *R. pacifica,* is described and illustrated here.

Ralfsia pacifica Hollenberg

Description.—The plant forms a flat encrusting layer (Fig. 27*a*), firmly attached to the substrate; it is irregularly circular in outline, often lobed at the margin, 2–12 cm. in diameter, 0.5–1.0 cm. thick, and olive brown to black in colour; surface with radial or concentric rings. In transverse section (Fig. 27*b*) the plant has a basal layer of radiating, laterally adherent, uniseriate filaments, terminating in free assimilating filaments or sporangia.

Habitat.—On rocks and shells in the middle and lower intertidal zones.

Pacific Coast Distribution.—Alaska to Mexico.

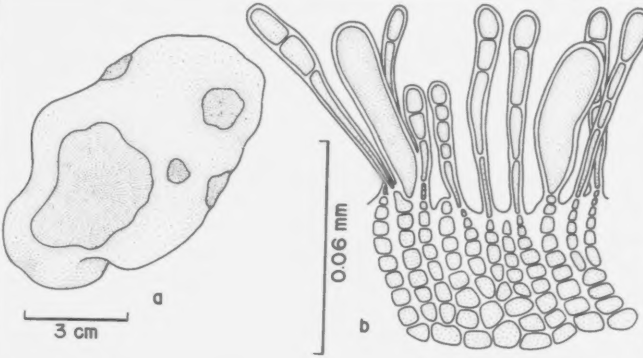


Fig. 27. *Ralfsia pacifica* Hollenberg. *a*, Rock showing several cushion-like encrusting plants; *b*, enlarged view showing arrangement of cells in transverse section of plant.

SPHACELARIA Lyngbye

Two species of the genus *Sphacelaria*—*S. racemosa* Greville and *S. subfusca* Setchell and Gardner—are recorded from British Columbia. Only one of these, *S. racemosa,* is described and illustrated here.

Sphacelaria racemosa **Greville**

Description.—The plant grows in small erect tufts (Fig. 28*a*), 1–5 cm. high; it is profusely branched, branching pinnately (Fig. 28*b*), with branchlets generally opposite and progressively longer from apex to base. Each branch terminates in a conspicuous apical cell (Fig. 28*d*); the region posterior to the apical cell is at first uniseriate (Fig. 28*d*), then multiseriate (Fig. 28*d*) with cells in regular transverse series (Fig. 28*c*).

Habitat.—On rocks, shells, and epiphytic on other algæ in the lower intertidal and upper subtidal zones.

Pacific Coast Distribution.—Bering Sea to Oregon.

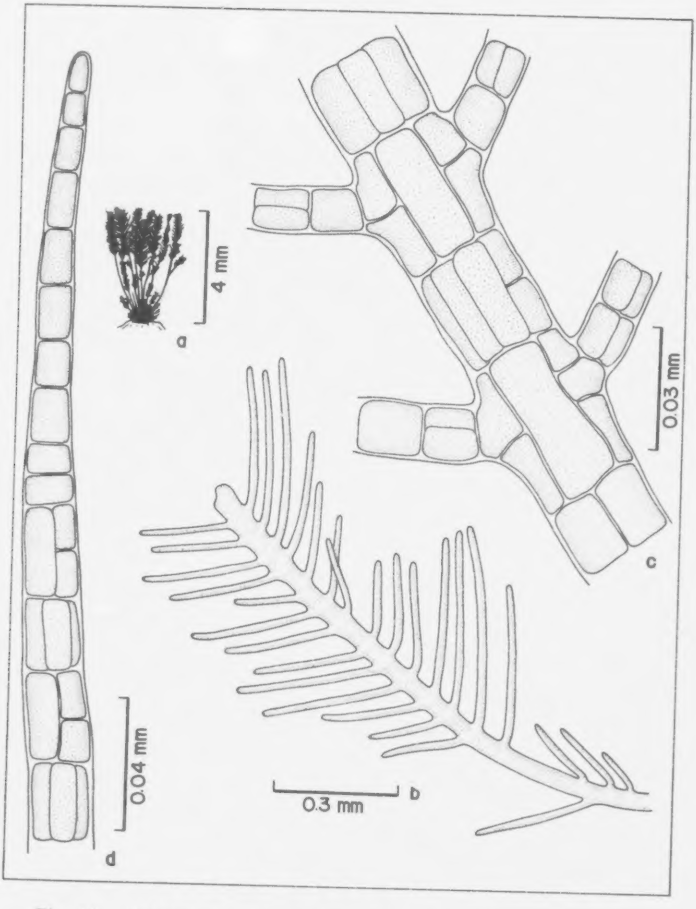


Fig. 28. *Sphacelaria racemosa* Greville. *a*, Habit, showing cluster of several plants; *b*, portion of plant showing pinnate branching habit; *c*, enlarged view of a portion of the plant showing cell arrangement; *d*, enlarged view of apex of plant showing apical cell.

LEATHESIA Gray

Only one species, *Leathesia difforimis* (L.) Areschoug, which is described and illustrated here, is recorded from British Columbia.

Leathesia difforimis (L.) Areschoug

Description.—The plant is spherical and solid when young, becoming irregularly convoluted (Fig. 29*a*), hollow and broadly expanded at maturity; it is spongy in texture, up to 12 cm. in diameter and yellowish brown in colour. The medulla is composed of colourless, free branched filaments of large cells; the cells are progressively smaller and compacted near the surface, and free assimilating filaments and long colourless hairs project beyond the surface (Fig. 29*b*).

Habitat.—On rocks and epiphytic on other algæ in the intertidal zone.

Pacific Coast Distribution.—Bering Sea to Mexico.

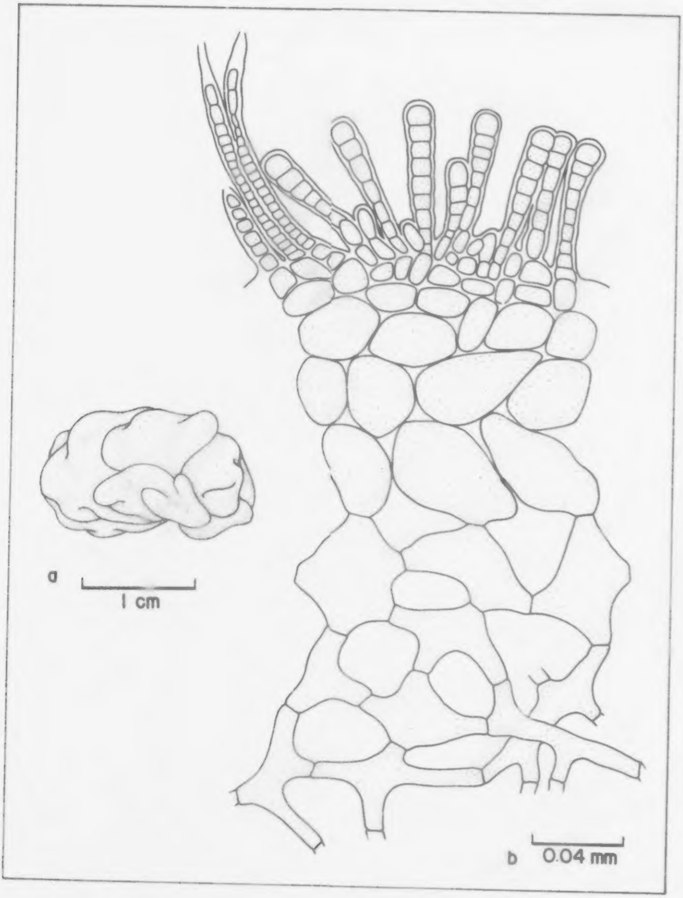


Fig. 29. *Leathesia difformis* (L.) Areschoug. *a*, Habit of plant, showing convoluted characteristic; *b*, enlarged view of a portion of the plant near the surface, as seen in transverse section.

HAPLOGLOIA Levring

Two species of the genus *Haplogloia*—*H. andersonii* (Farlow) Levring and *H. kuckuckii* Kylin—are recorded from British Columbia. Only one of these, *H. andersonii,* is described and illustrated here.

***Haplogloia andersonii* (Farlow) Levring**

Description.—The plant is erect, 25–50 cm. high, sometimes with several cylindrical axes, 1–3 mm. in diameter, arising from a common base (Fig. 30*a*); profusely branched, branching radial to a percurrent axis; clothed with long unbranched multicellular hairs (Fig. 30*c*), except near the base; soft and slimy in texture; light tan to dark brown in colour. The plant is filamentous throughout, with branched filaments densely compacted, in mature parts having medulla of compacted vertical filaments with long cylindrical cells and cortex of unbranched free filaments standing perpendicular to the medulla (Fig. 30*c*).

Habitat.—On rocks in the lower intertidal zone.

Pacific Coast Distribution.—Alaska to Mexico.

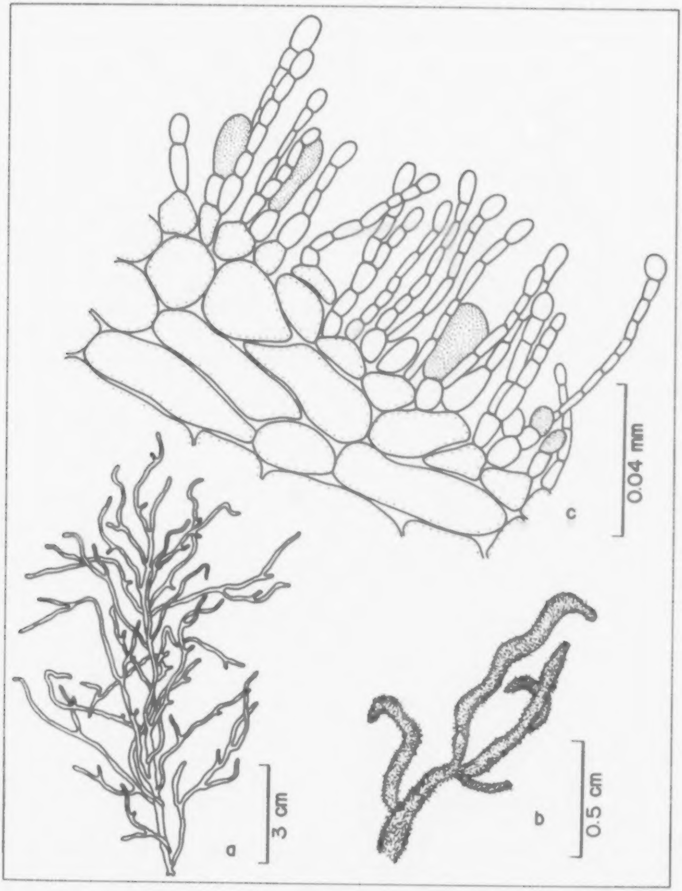


Fig. 30. *Haplogloia andersonii* (Farlow) Levring. *a*, Habit of plant, showing irregular branching; *b*, enlarged portion of plant showing covering of hair-like filaments; *c*, detail of cells and hair-like filaments at surface of plant, as seen in transverse section at high magnification.

HETEROCHORDARIA Setchell and Gardner

Only one species, *Heterochordaria abietina* (Ruprecht) Setchell and Gardner, which is described and illustrated here, is recorded from British Columbia.

Heterochordaria abietina (Ruprecht) Setchell and Gardner

Description.—The plant has one or more erect axes arising from a common conspicuous, lobed, encrusting holdfast. The erect portion (Fig. 31*a*) has a percurrent cylindrical axis, up to 30 cm. high, clothed on all sides with short cylindrical to flattened branchlets up to 3 cm. long; light tan to dark brown in colour. Medulla of cylindrical, vertically elongated colourless cells; cortex of laterally adherent assimilating filaments (Fig. 31*b*), standing free and perpendicular to the medulla; sometimes hollow at maturity.

Habitat.—On rocks in the middle and lower intertidal zones.

Pacific Coast Distribution.—Bering Sea to California.

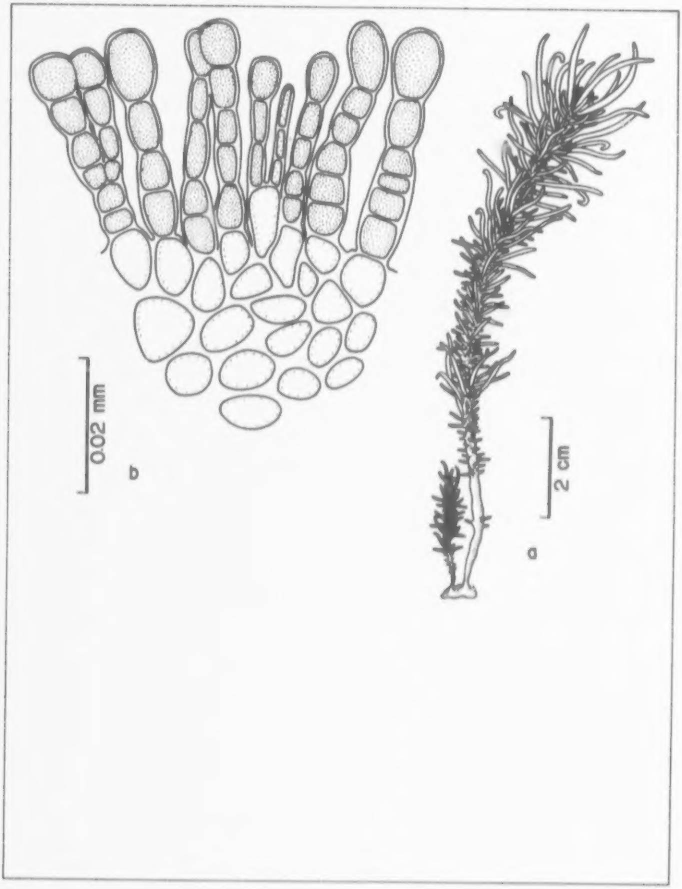


Fig. 31. *Heterochordaria abietina* (Ruprecht) Setchell and Gardner. *a*, Habit of plant; *b*, detail of cells at the surface of the plant, as seen at high magnification in transverse section.

DESMARESTIA Lamouroux

Nine species of the genus *Desmarestia*—*D. farcta* Setchell and Gardner, *D. foliacea* Pease, *D. herbacea* Lamouroux, *D. intermedia* Postels and Ruprecht, *D. latissima* Setchell and Gardner, *D. ligulata* (Lightfoot) Lamouroux, *D. media* (C. Agardh) Greville, *D. munda* Setchell and Gardner, and *D. viridis* (Müller) Lamouroux —are recorded from British Columbia. Five of these—*D. foliacea, D. herbacea, D. intermedia, D. ligulata,* and *D. munda*—are described and illustrated here.

Desmarestia foliacea Pease

Description.—The plant is thin and membranous, brittle, unbranched (Fig. 32*a*), up to 1 m. high and 15 cm. wide, tapering below to a slender stipe and a small discoid holdfast; light brown in colour. The margin is irregularly lobed, occasionally dentate. There is a conspicuous percurrent midrib with opposite branches which subdivide and terminate in fine veins.

Habitat.—On rocks in the upper subtidal zone.

Pacific Coast Distribution.—British Columbia to Washington.

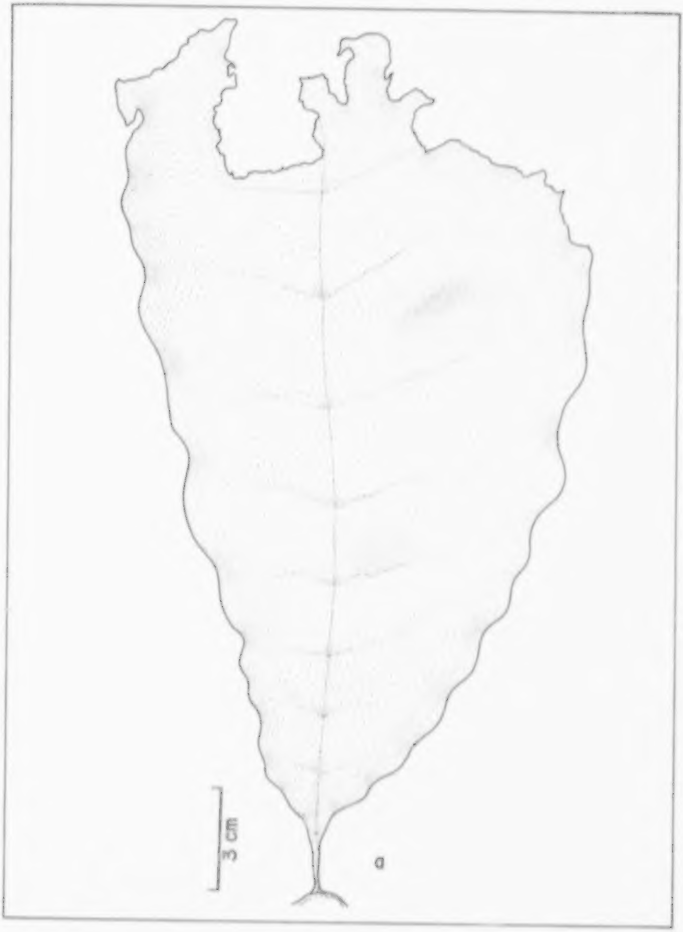


Fig. 32. *Desmarestia foliacea* Pease. *a*, Habit of plant attached to substrate.

Desmarestia herbacea **Lamouroux**

Description.—The plant (Fig. 33*a*) is erect, up to 2 m. high, flattened, 1–2 cm. wide, tapering abruptly to a short cylindrical stipe and a discoid holdfast. The plant has 3–4 orders of branches from a percurrent axis; branching opposite; base of branches stipitate. The main axis and branches have a conspicuous thick percurrent midrib, and branch apices are densely clothed with acute hairs.

Habitat.—On rocks in the lower intertidal and upper subtidal zones.

Pacific Coast Distribution.—Alaska to Mexico.

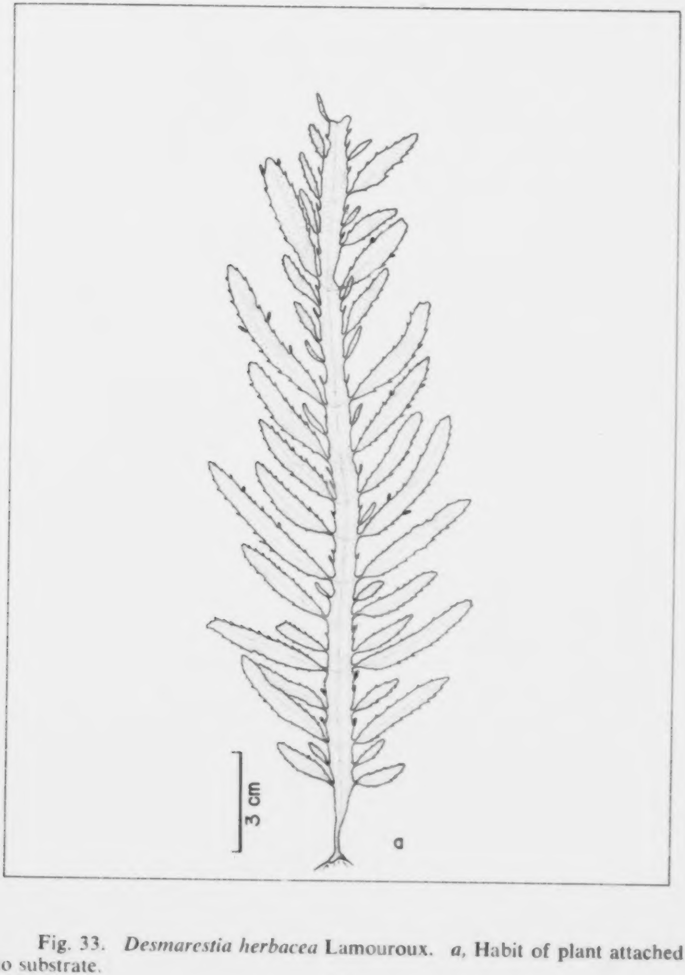


Fig. 33. *Desmarestia herbacea* Lamouroux. *a,* Habit of plant attached to substrate.

Desmarestia intermedia Postels and Ruprecht

Description.—Plant (Fig. 34*a*) dark brown in colour, up to 60 cm. high, very profusely branched, wiry; branches mostly compressed, about 1.5 mm. wide except near the base, where the main axes are up to 5 mm. wide and cylindrical. Branching is fasiculate below, mostly alternate above, occasionally opposite.

Habitat.—On rocks in the upper subtidal zone.

Pacific Coast Distribution.—Bering Sea to Oregon.

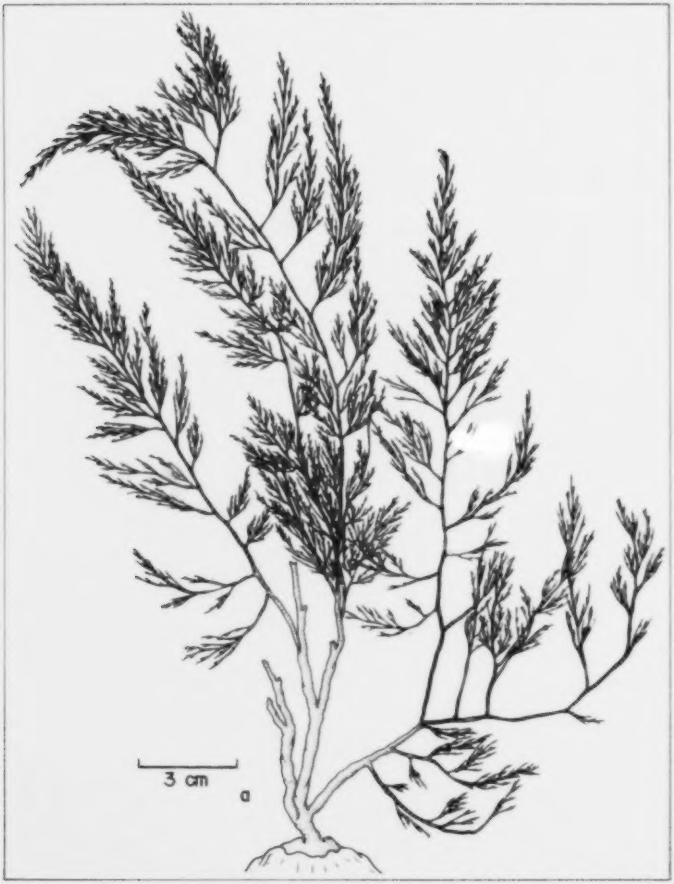


Fig. 34. *Desmarestia intermedia* Postels and Ruprecht. *a*, Habit of plant attached to substrate.

***Desmarestia ligulata* (Lightfoot) Lamouroux**

Description.—The plant (Fig. 35*a*) is yellowish brown to dark brown in colour, profusely branched, up to 80 cm. high, up to 8 mm. wide in broadest branches, tapering at the base to a conspicuous discoid holdfast. The primary axis gives rise to close-set opposite branches which are further branched 2–3 times; all orders of branching flattened and in the same plane. Midrib is barely discernible in main axes. Apices of branches clothed with fine hairs.

Habitat.—On rocks and shells in the lower intertidal and upper subtidal zones.

Pacific Coast Distribution.—British Columbia to Washington.

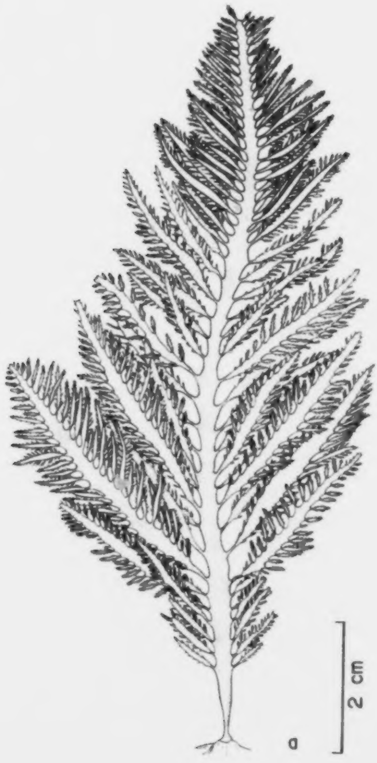


Fig. 35. *Desmarestia ligulata* (Lightfoot) Lamouroux. *a*, Habit of plant attached to substrate.

Desmarestia munda Setchell and Gardner

Description.—The plant (Fig. 36*a*) is yellowish brown to dark brown in colour, rigid, 4–8 m. tall, ligulate, 2–10 cm. wide, with a percurrent sparsely branched axis with short laterals and spines in opposite pairs throughout the length of the plant. The ligulate main axis tapers to a short stipe, which is cylindrical at the base and merges into a stout discoid holdfast. The branches are stipitate at the base. There is a conspicuous midrib on the stipe and lower parts of the plant, which becomes less conspicuous above and ultimately appears only as a delicate vein.

Habitat.—On rocks in the lower intertidal and upper subtidal zones and to a depth of 10 fathoms.

Pacific Coast Distribution.—British Columbia to Mexico.

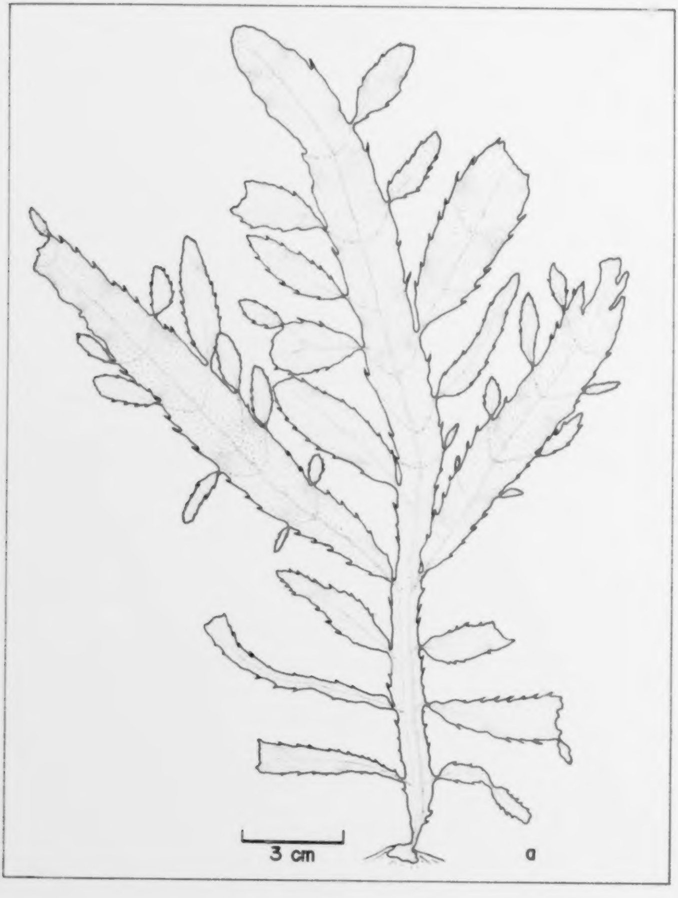


Fig. 36. *Desmarestia munda* Setchell and Gardner. *a*, Habit of plant attached to substrate.

PUNCTARIA Greville

Three species of the genus *Punctaria*—*P. expansa* Setchell and Gardner, *P. hesperia* Setchell and Gardner, and *P. orbiculata* Jao—are recorded from British Columbia. One of these, *D. hesperia,* is described and illustrated here.

***Punctaria hesperia* Setchell and Gardner**

Description.—The plant occurs as a small epiphyte (Fig. 37*b*), attached in clusters (Fig. 37*a*) to the leaves of *Phyllospadix* and *Zostera.* It is flaccid, light brown in colour, 1.5–2.5 cm. high, linear, 5–10 mm. wide, broadly cuneate at the base, tapering to a very short stipe and a small discoid holdfast. The plant is 4–6 layers of cells thick (Fig. 37*c*), with those of two middle layers being thin-walled and larger than the cortical cells. The surface cells have thicker walls and contain numerous band-shaped chloroplasts.

Habitat.—Epiphytic on *Phyllospadix* and *Zostera.*

Pacific Coast Distribution.—British Columbia to California.

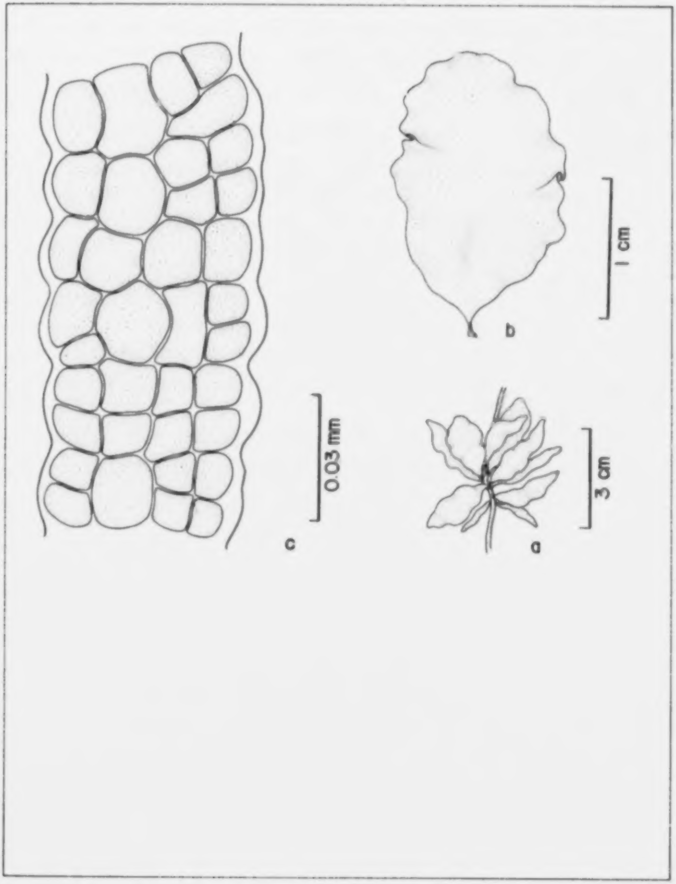


Fig. 37. *Punctaria hesperia* Setchell and Gardner. *a*, *Habit*, showing group of plants epiphytic on sea grass; *b*, habit of a single plant; *c*, enlarged view showing arrangement of cells as seen in transverse section of the plant.

SORANTHERA Postels and Ruprecht

Only one species, *Soranthera ulvoidea* Postels and Ruprecht, which is described and illustrated here, is recorded for this genus from British Columbia.

Soranthera ulvoidea Postels and Ruprecht

Description.—The plant (Fig. 38*b*), which occurs as a pale olive-brown epiphyte on *Odonthalia* (Fig. 38*a*) and *Rhodomela*, is solid and globose when young; at maturity it is hollow and ellipsoid. It is attached by a small discoid holdfast. The saccate portion, which is 3–7 cm. tall and 2–4 cm. broad, has dark-brown sori, about 1 mm. in diameter, scattered evenly over the surface (Fig. 38*b*). The saccate portion of the plant is 5–6 cells thick, with the surface cells much smaller than those within (Fig. 38*c*). The sporangia are grouped in sori together with multicellular hairs and paraphyses (Fig. 38*c*).

Habitat.—Epiphytic on species of *Rhodomela* and *Odonthalia*.

Pacific Coast Distribution.—Bering Sea to California.

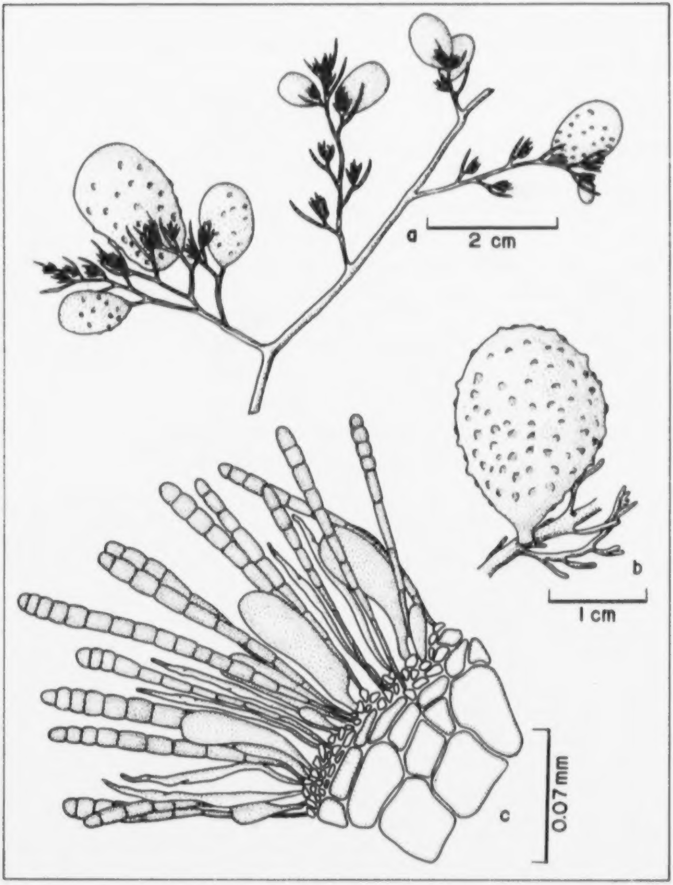


Fig. 38. *Soranthera ulvoidea* Postels and Ruprecht. *a*, Habit, showing several saccate plants growing epiphytically on *Odonthalia floccosa; b*, enlarged view of single plant attached to *Odonthalia flocossa; c*, detail of a portion of the plant showing cells at the surface, as seen at high magnification in transverse section.

SCYTOSIPHON C. Agardh

Two species of the genus *Scytosiphon*—*S. bullosus* Saunders and *S. lomentaria* (Lyngbye) J. Agardh, both of which are described and illustrated here—are recorded from British Columbia.

Scytosiphon bullosus Saunders

Description.—The plant (Fig. 39*a*) has a smooth surface, is pale olive brown or yellowish brown in colour, 1–10 cm. high, with several erect hollow axes arising from a broad tuberculate sessile base. The mature plant is saccate, more or less compressed, broadly rounded at the apex, often with one or more finger-like extensions (Fig. 39*a*). The innermost cells (Fig. 39*b*) are larger than those near the surface, and short assimilating filaments cover the whole plant.

Habitat.—On rocks and epiphytic on other algæ.

Pacific Coast Distribution.—Alaska to Mexico.

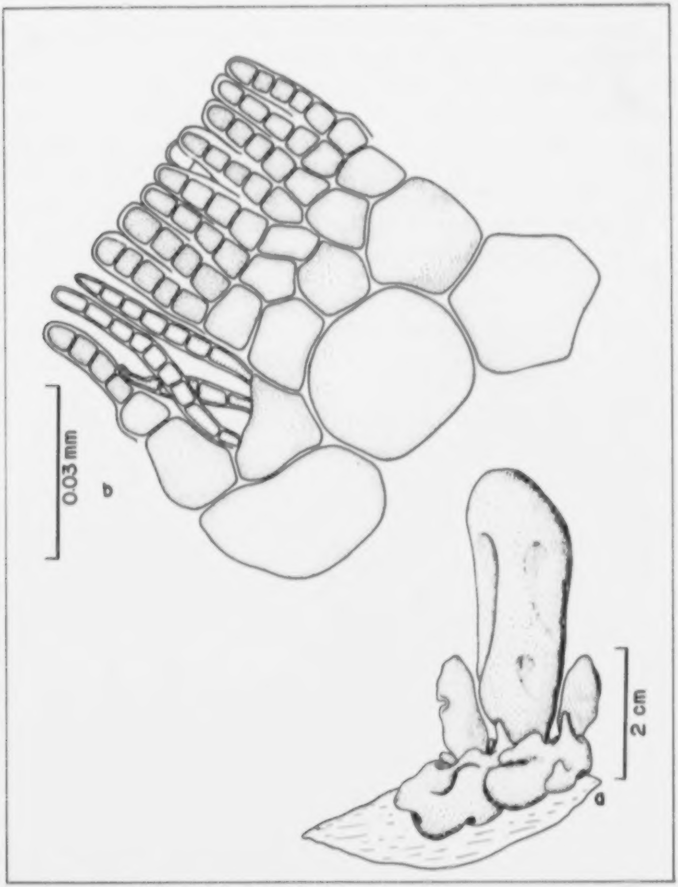


Fig. 39. *Scytosiphon bullosus* Saunders. *a*, Habit of plant attached to substrate; *b*, detail of a portion of the plant showing cells at surface, as seen in transverse section at high magnification.

Scytosiphon lomentaria (Lyngbye) J. Agardh

Description.—The plant, which is olive brown to dark brown in colour, grows in erect clusters (Fig. 40*a*) from a common disk-shaped holdfast. It is tubular, up to 50 cm. tall and 1 cm. in diameter, unbranched, with or without constrictions at intervals, often compressed. The plant is several cells thick, with large cells next to the hollow centre, becoming progressively smaller toward the surface (Fig. 40*b*).

Habitat.—On rocks in the lower intertidal zone.

Pacific Coast Distribution.—Bering Sea to Mexico.

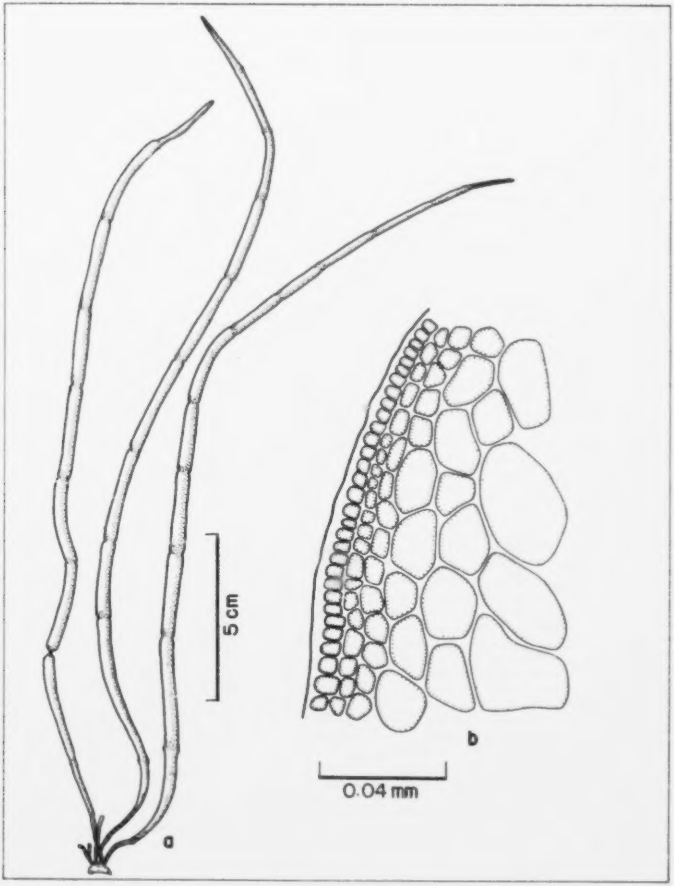


Fig. 40. *Scytosiphon lomentaria* (Lyngbye) J. Agardh. *a*, Habit of a group of plants; *b*, detail of a portion of the plant showing cells at the surface, as seen in transverse section at high magnification.

PETALONIA Derbès and Solier

Only one species of the genus *Petalonia, P. debilis* (C. Agardh) Derbès and Solier, which is described and illustrated here, is recorded from British Columbia.

Petalonia debilis (C. Agardh) Derbès and Solier

Description.—The plant is greenish brown to dark brown in colour and occurs in small flaccid tufts (Fig. 41*b*) on rocks or epiphytic on leaves of *Phyllospadix* and *Zostera.* The erect blade is linear to broadly lanceolate, up to 35 cm. long and 12 cm. wide, tapering above to a pointed apex and below to a short stipe and discoid holdfast. The margin of the blade is undulate. The plant has several layers of large, rounded, thin-walled cells making up a compact medulla, and a cortex of cubical smaller cells (Fig. 41*a*). The surface cells have one parietal chloroplast.

Habitat.—On rocks and epiphytic on leaves of *Phyllospadix* and *Zostera* in the lower intertidal zone.

Pacific Coast Distribution.—Alaska to Mexico.

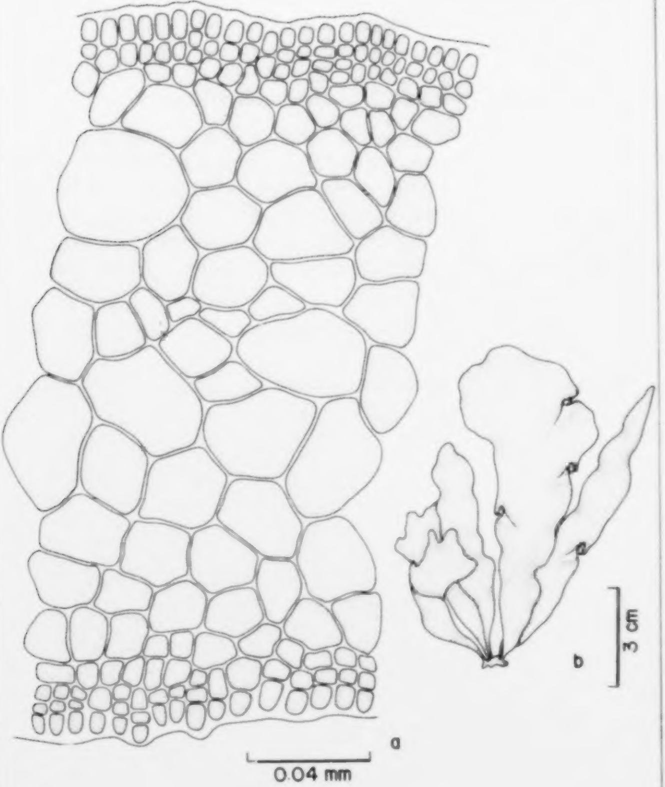


Fig. 41. *Petalonia debilis* (C. Agardh) Derbès and Solier. *a*, Habit of group of plants; *b*, enlarged view showing arrangement of cells as seen in a transverse section of the plant.

COLPOMENIA Derbès and Solier

Only one species of the genus *Colpomenia, C. sinuosa* (Roth) Derbès and Solier, which is described and illustrated here, is recorded from British Columbia

Colpomenia sinuosa (Roth) Derbès and Solier

Description.—The plant is solid and spherical when young, becoming a crisp hollow, water-filled, irregularly globose sac (Fig. 42*b*) at maturity, 4–10 cm. in diameter. The plant is olive brown to dark brown in colour, sessile, fastened by a broad basal disk to other algæ. The saccate portion is several cells thick without intercellular spaces. The inner cells are very large, and the outer cells are much smaller (Fig. 42*a*).

Habitat.—On rocks and epiphytic on other algæ in the middle and lower intertidal zones.

Pacific Coast Distribution.—Alaska to Mexico.

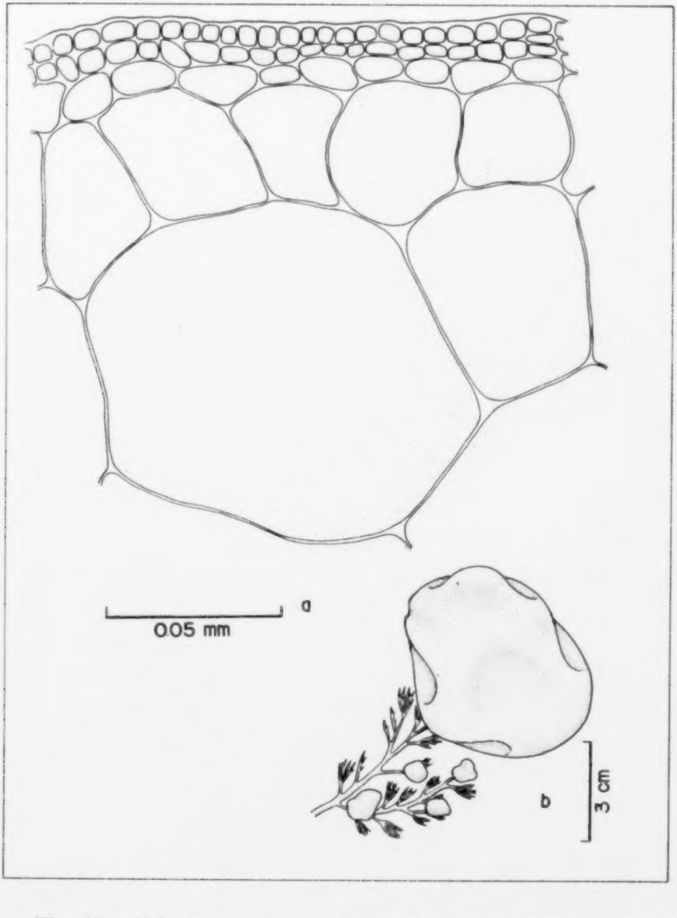


Fig. 42. *Colpomenia sinuosa* (Roth) Derbès and Solier. *a*, Habit showing several plants growing epiphytically on *Odonthalia floccosa*; *b*, detail of a portion of the plant showing cells at surface, as seen in transverse section at high magnification.

COILODESME Stroemfelt

Two species of the genus *Coilodesme*—*C. bulligera* Stroemfelt and *C. californica* (Ruprecht) Kjellman, both of which are described and illustrated here—are recorded from British Columbia.

Coilodesme bulligera Stroemfelt

Description.—The plant occurs in tufts (Fig. 43*a*), 5–12 cm. high, is saccate, collapsing readily when out of water. The apex is rounded and the base tapers to a short stipe and discoid holdfast (Fig. 43*b*). The plant is 1–2 cm. in diameter and is dark brown in colour. The inner two layers of cells are large, and the cortex is of small cells (Fig. 43*c*).

Habitat.—On rocks in the lower intertidal zone.

Pacific Coast Distribution.—Alaska to Oregon.

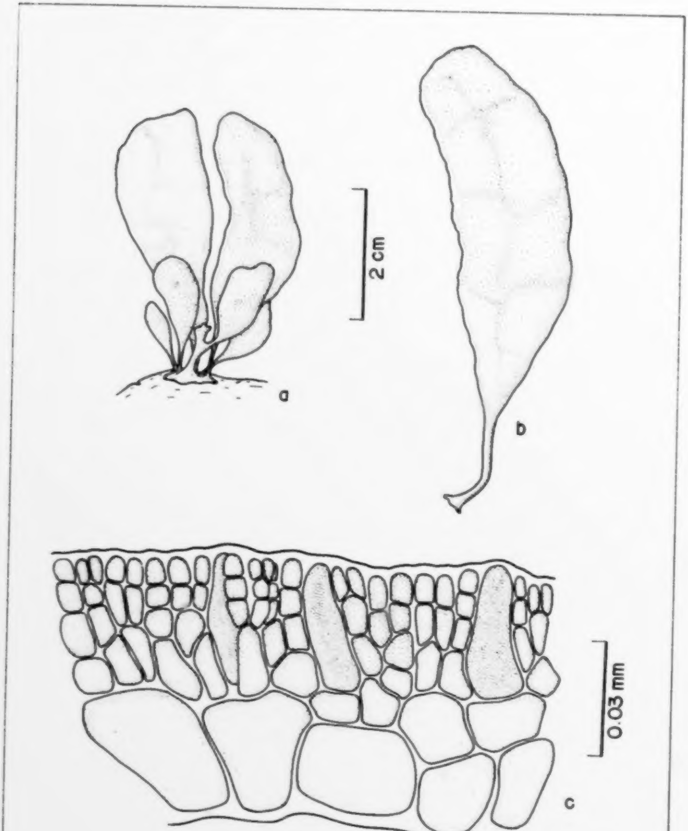


Fig. 43. *Coilodesme bulligera* Stroemfelt. *a*, Habit of a cluster of saccate plants; *b*, habit of a single plant; *c*, detail showing cells as seen in a transverse section through a portion of the wall of the saccate plant.

Coilodesme californica (Ruprecht) Kjellman

Description.—The plant is a linear to obovate flaccid sac, smooth at first, becoming markedly flattened, wrinkled and with the upper end frequently frayed at maturity. It is light olive tan in colour, 25–35 cm. long and up to 12 cm. wide, and occurs as an epiphyte on *Cystoseira* (Fig. 44*a*). The basal portion tapers abruptly to a short cylindrical stipe and a small discoid holdfast. The wall of the sac has an inner region of large cells which become progressively smaller toward the surface (Fig. 44*b*).

Habitat.—Epiphytic on *Cystoseira geminata.*

Pacific Coast Distribution.—British Columbia to Mexico.

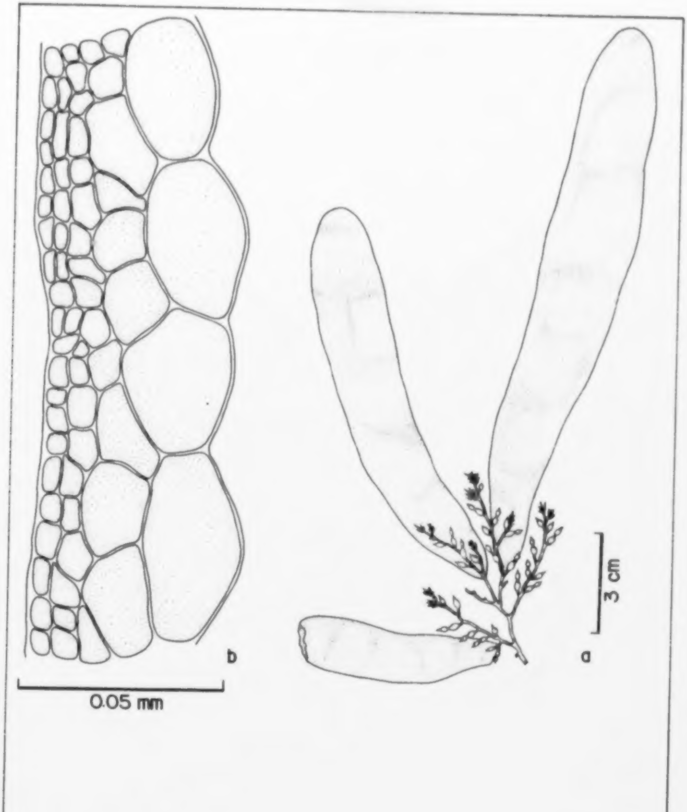


Fig. 44. *Coilodesme californica* (Ruprecht) Kjellman. *a,* Habit, showing three plants growing epiphytically on *Cystoseira geminata; b,* detail showing cells as seen in a transverse section through a portion of the wall of the saccate plant.

PHÆOSTROPHION Setchell and Gardner

Only one species of the genus *Phæostrophion, P. irregulare* Setchell and Gardner, which is described and illustrated here, is recorded from British Columbia.

Phæostrophion irregulare Setchell and Gardner

Description.—The blade-like plant is ligulate (Fig. 45*a*), irregularly lobed or notched, 15–40 cm. high and 1.5–4 cm. wide, tapering to a narrow stipitate region. One or more blades arise from a holdfast (Fig. 45*b*). The plants grow in dense stands and are dark brown in colour. The plant is polystromatic with a medulla of large thick-walled cells gradually merging into a cortex of small cells. (Fig. 45*c*).

Habitat.—Growing on rocks and in tide-pools in the middle and lower intertidal zones.

Pacific Coast Distribution.—Alaska to California.

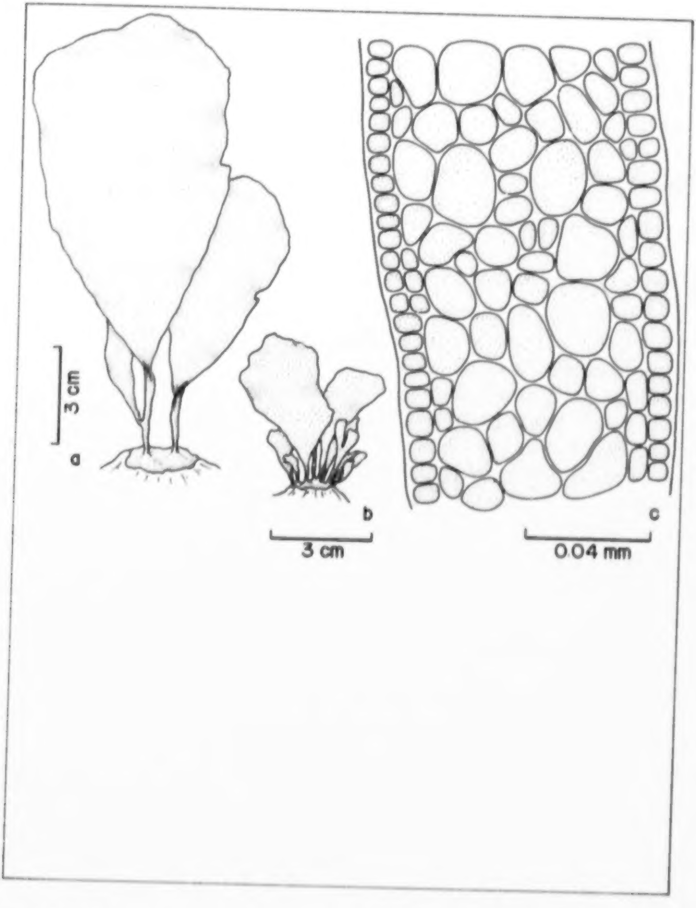


Fig. 45. *Phæostrophion irregulare* Setchell and Gardner. *a*, Habit of a cluster of plants; *b*, habit, showing two enlarged plants; *c*, enlarged view showing arrangement of cells as seen in transverse section of the plant.

LAMINARIA Lamouroux

The genus *Laminaria* is represented in British Columbia by several varieties in at least seven species—*L. complanata* (Setchell and Gardner) Setchell, *L. ephemera* Setchell, *L. farlowii* Setchell, *L. grœnlandica* Rosenvinge, *L. saccharina* (L.) Lamouroux, *L. setchellii* Silva, *L. sinclairii* (Harvey *ex* Hooker and Harvey Farlow, Anderson and Eaton, and *L. yezœnsis Miyabe.* Three of these, *L. cuneifolia, L. saccharina,* and *L. setchellii,* are described and illustrated here.

Laminaria grœnlandica Rosenvinge

Description.—The plant (Fig. 46*a*) is dark brown to black in colour with a conspicuous holdfast, blade, and stipe. The stipe varies in length from 10 cm. or less to 60 cm. in length, from terete to complanate, and is 3–4 mm. in diameter. The holdfast is relatively small, made up of many branched root-like structures. The blade is 60–90 cm. long, 7–12 cm. wide, sometimes deeply dissected, and it may be completely smooth, with only two rows of bullations, or densely bullate over the entire surface. The base of the blade is broadly rounded.

Habitat.—On rocks in the upper subtidal zone.

Pacific Coast Distribution.—Bering Sea to Oregon.

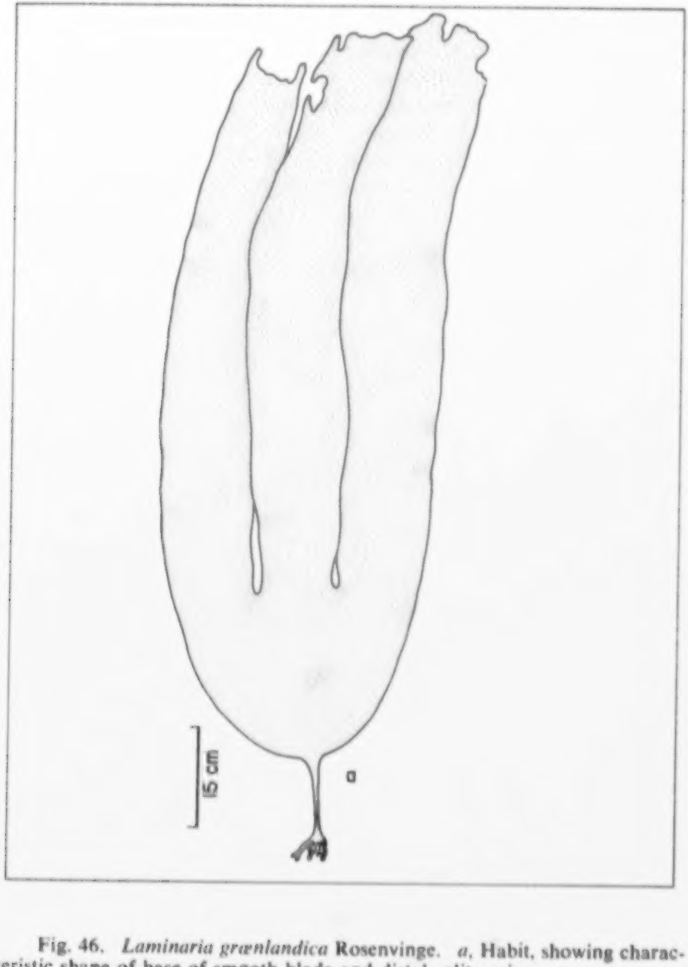


Fig. 46. *Laminaria grœnlandica* Rosenvinge. *a*, Habit, showing characteristic shape of base of smooth blade and distal split region.

Laminaria saccharina (L.) Lamouroux

Description.—The plant (Fig. 47*a*) is a rich brown colour with a conspicuous holdfast, blade, and stipe. The holdfast is composed of branched root-like structures. The stipe varies in length from 5 to 50 cm., from 6 to 9 mm. in diameter, is terete, flattening above to the base of the blade. The blade is smooth, with or without two rows of bullations, sometimes undulate, and tapered to broadly rounded at the base; it is 12–18 cm. broad and 2.5–3.5 m. long.

Habitat.—On rocks in the lower intertidal and upper subtidal zones.

Pacific Coast Distribution.—Alaska to Oregon and in the Channel Islands, California.

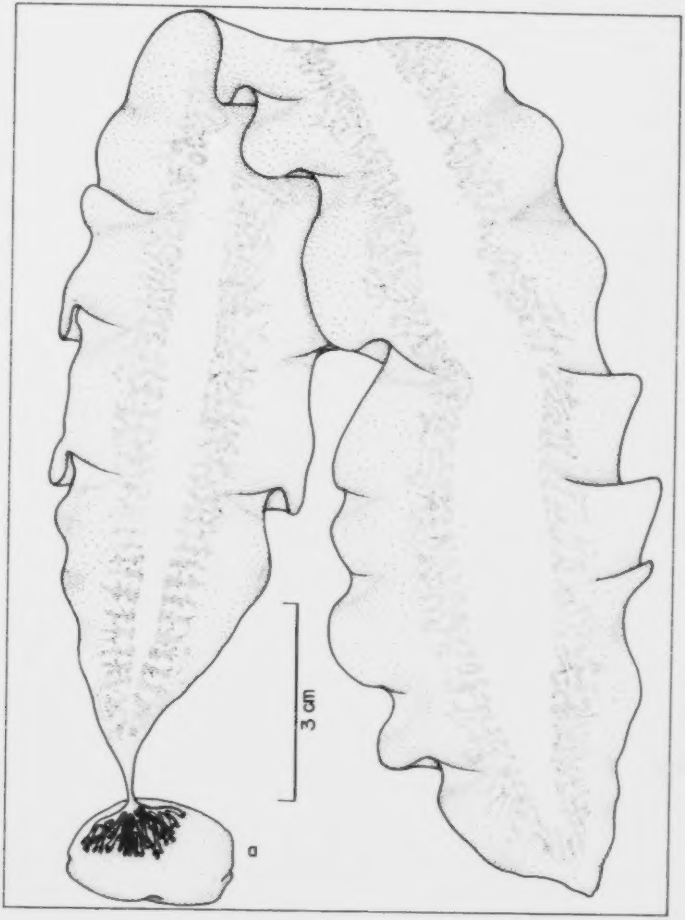


Fig. 47. *Laminaria saccharina* (L.) Lamouroux. *a*, Habit of plant attached to substrate, showing ruffled characteristic of blade.

Laminaria setchellii Silva

Description.—The plant (Fig. 48*a*) is a rich brown to almost black colour with a prominent stipe, holdfast, and blade. The stipe, which is up to 1.5 m. long, is rigid, up to a length of 50 cm., arising from a stout holdfast of branched overlapping short rootlike structures; it is 2 cm. or greater in diameter at maturity, tapering above to the flat blade. The blade is usually deeply dissected almost to the base into several segments; the base of the blade is cuneate to broadly rounded. The blade is 15–25 cm. wide and 50–80 cm. long.

Habitat.—On rocks in the lowermost intertidal zone and upper subtidal zone on the exposed parts of the Coast.

Pacific Coast Distribution.—Alaska to California.

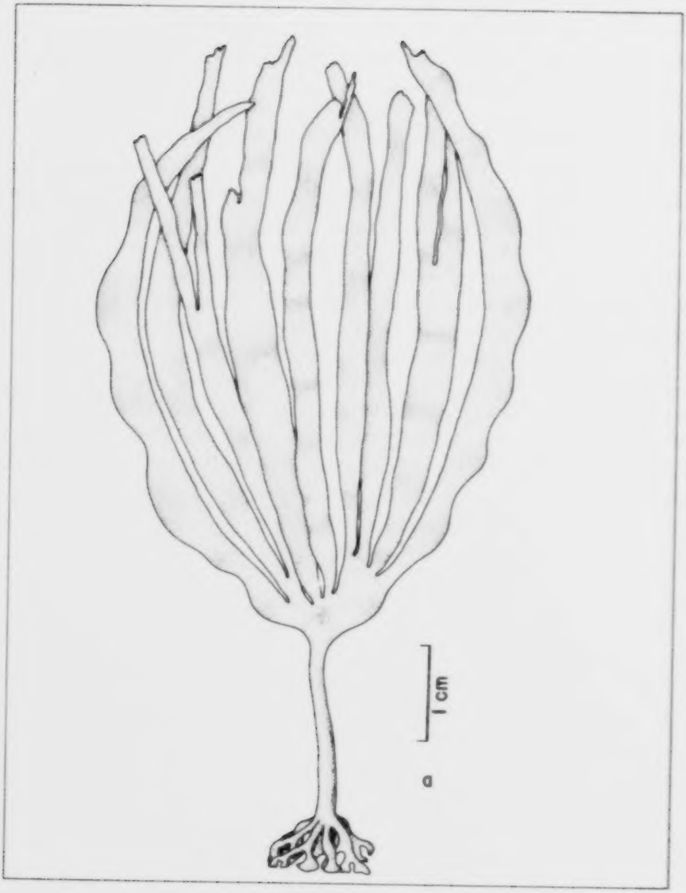


Fig. 48. *Laminaria setchellii* Silva. *a*, Habit, showing long stout stipe and characteristic deeply dissected blade.

PLEUROPHYCUS Setchell and Gardner

Only one species of the genus *Pleurophycus, P. gardneri* Setchell and Saunders, which is described and illustrated here, is recorded from British Columbia.

Pleurophycus gardneri Setchell and Saunders

Description.—The plant (Fig. 49*a*) is dark olive brown to black in colour, blade-like, with a broad flat unbranched lamina up to 90 cm. long and 40 cm. wide at the end of a stout stipe up to 50 cm. long. The stipe is flattened above where it is attached to the blade and becomes cylindrical below near the branched root-like holdfast. The blade has a smooth undulate margin and is usually eroded away at the outer end; it has a rounded or cuneate base. A conspicuous median, flat midrib up to 4 cm. wide runs the full length of the blade and merges into the stipe. Delicate wrinkles occur along both sides of the midrib, and these merge into the ruffled undulate margins.

Habitat.—On rocks in the lower intertidal and upper subtidal zones.

Pacific Coast Distribution.—Alaska to Oregon.

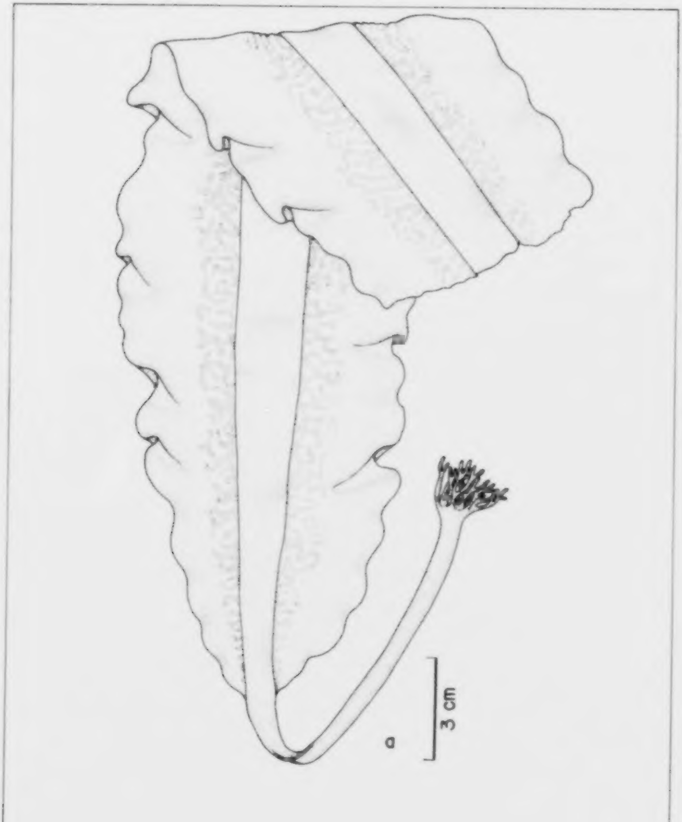


Fig. 49. *Pleurophycus gardneri* Setchell and Saunders. *a*, Habit, showing stout stipe, ruffled blade, with characteristic smooth midrib.

CYMATHERE J. Agardh

Only one species of the genus *Cymathere, C. triplicata* (Postels and Ruprecht) J. Agardh, which is described and illustrated here, is recorded from British Columbia.

Cymathere triplicata (Postels and Ruprecht) J. Agardh

Description.—The blade-like plant (Fig. 50*a*) is yellowish brown, with a linear undivided blade up to 4 m. long and 18 cm. wide; the blade is thick and rigid below, thinner above; three to five prominent longitudinal folds run the full length of the blade. The base of the blade tapers (or is broadly rounded) to a stipe that is up to 25 cm. long, flattened above and cylindrical below, where it terminates in a prominent discoid holdfast.

Habitat.—On rocks in the upper subtidal zone.

Pacific Coast Distribution.—Bering Sea to Washington.

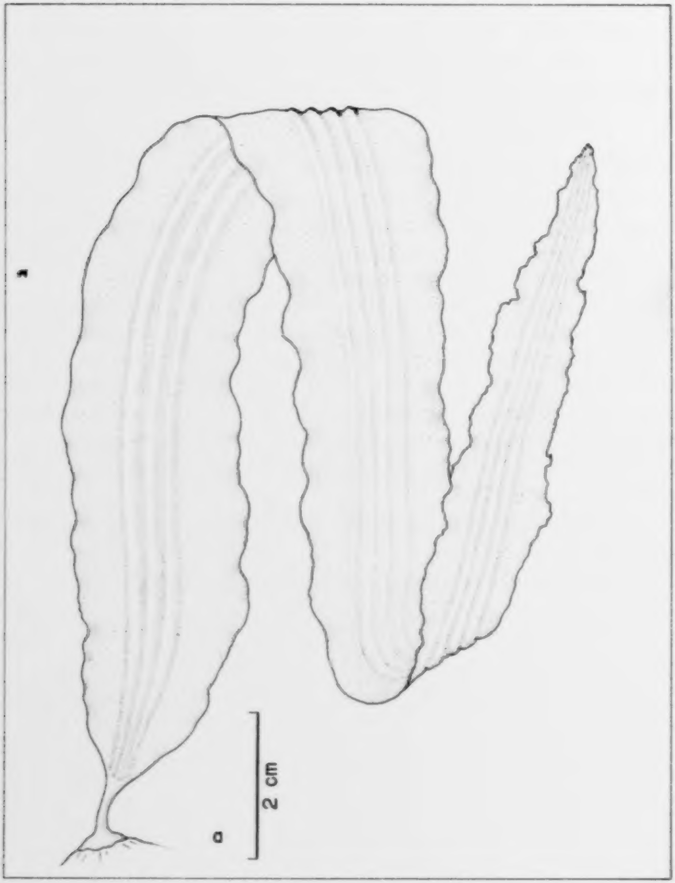


Fig. 50. *Cymathere triplicata* (Postels and Ruprecht) J. Agardh. *a*, Habit, showing discoid holdfast fastened to substrate and characteristic folds running the length of the blade.

COSTARIA Greville

Two poorly demarcated species of the genus *Costaria*—*C. costata* (Turner) Saunders and *C. mertensii* J. Agardh—are recorded from British Columbia. One of these, *C. costata,* is described and illustrated here.

Costaria costata **(Turner) Saunders**

Description.—The blade-like plant (Fig. 51*a*) is dark brown in colour; the linear undivided blade has 5–7 longitudinal parallel percurrent ribs and tapers gradually (or is sometimes markedly cordate at the base) to a conspicuous stipe. The blade is from 10 to 30 cm. wide and from 50 to 250 cm. long; each rib projects on one side of the blade only, and the emergence alternates from side to side from one rib to the next; the blade is coarsely bullate. The stipe is from 3 mm. to 1.5 cm. wide and from 5 to 65 cm. long; it is flattened through most of its length, becoming terete generally only where it merges with the profusely branched root-like holdfast; the surface of the stipe has numerous fine parallel longitudinal grooves.

Habitat.—On rocks and wood in the lower intertidal and upper subtidal zones.

Pacific Coast Distribution.—Alaska to California.

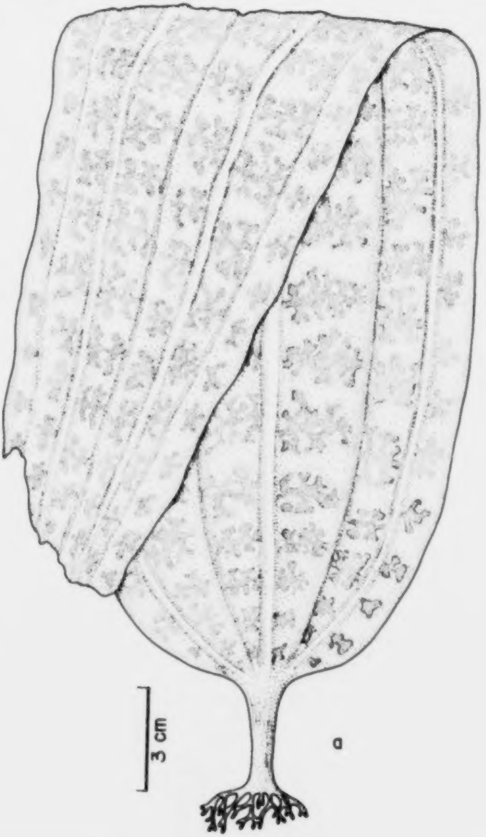


Fig. 51. *Costaria costata* (Turner) Saunders. *a*, Habit, showing bullate plant with longitudinal ribs running the length of the blade.

AGARUM (Bory) Postels and Ruprecht

Two species of the genus *Agarum*—*A. cribrosum* Bory and *A. fimbriatum* Harvey—both of which are described and illustrated here, are recorded from British Columbia.

Agarum cribrosum Bory

Description.—The blade-like plant (Fig. 52*a*) is dark brown, rigid, with an undivided smooth profusely perforate blade; the blade is broadly ovate, 50–90 cm. long and 20–50 cm. wide, with a cordate base and a smooth margin. A median, slightly differentiated non-perforated and non-emergent region, 1.5–3 cm. wide, is percurrent on the blade. The stipe is cylindrical, 3–30 cm. long and 5–8 mm. in diameter, and merges into a small branched root-like holdfast.

Habitat.—On rocks in the upper subtidal zone down to a depth of at least 5 fathoms.

Pacific Coast Distribution.—Bering Sea to Washington.

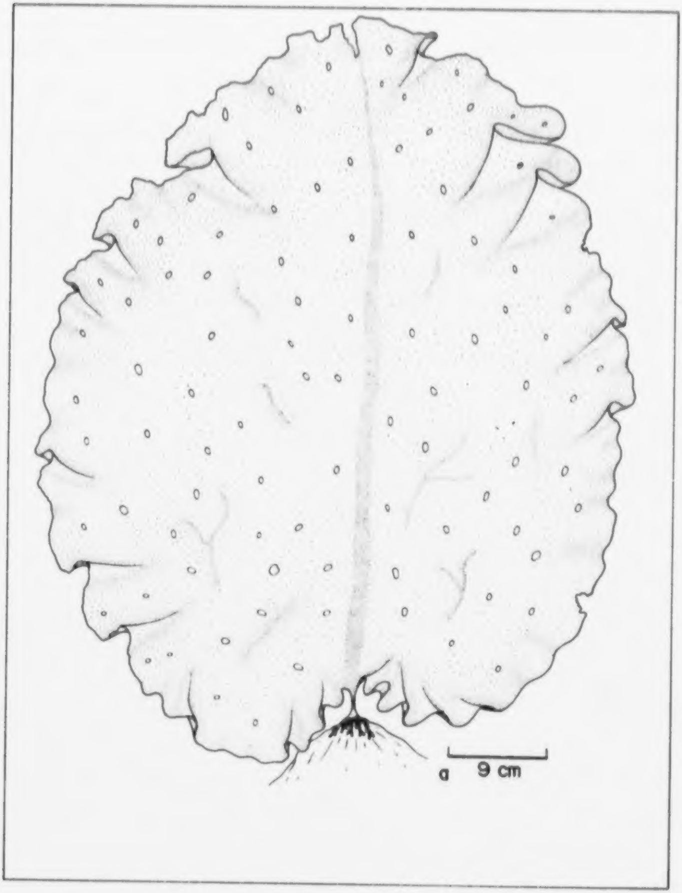


Fig. 52. *Agarum cribrosum* Bory. *a*, Habit, showing ruffled perforate blade with smooth median midrib, attached to substrate.

Agarum fimbriatum Harvey

Description.—The blade-like plant (Fig. 53*a*) is dark brown in colour, with a thin, elliptical to elongate, finely and densely bullate blade 20–80 cm. long and 15–25 cm. wide. The base of the blade is rounded to cordate and the margins are dentate. The blade is usually frayed at the outer end. Small perforations are sometimes present, but not abundant. There is a median longitudinal, slightly differentiated region, which is smooth and devoid of perforations. The stipe is flat above, 2–6 cm. long and 4–7 mm. wide, with numerous coarse hair-like extensions on the margins, and terete below where it merges into a branched root-like holdfast.

Habitat.—On rocks from the upper subtidal zone down to a depth of several fathoms.

Pacific Coast Distribution.—British Columbia to California.

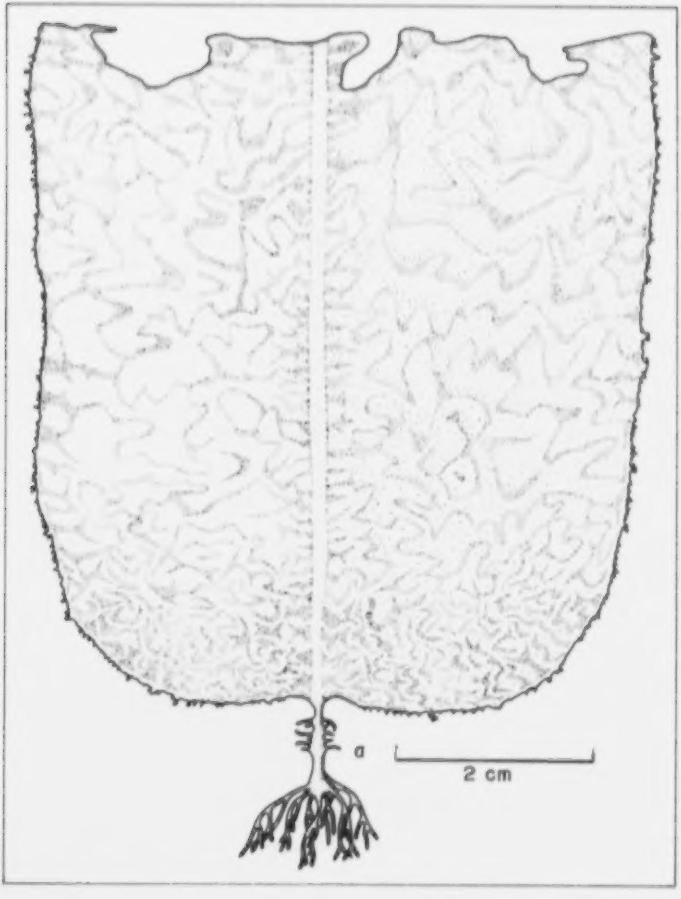


Fig. 53. *Agarum fimbriatum* Harvey. *a*, Habit, showing ruffled surface of blade, dentate margin, smooth median midrib, and lateral hair-like outgrowths on the stipe.

HEDOPHYLLUM Setchell

Only one species, *Hedophyllum sessile* (C. Agardh) Setchell, which is described and illustrated here, is recorded for this genus from British Columbia.

Hedophyllum sessile **(C. Agardh) Setchell**

Description.—The plant (Fig. 54*a*) is an ovate blade with a short stipe when young, but the stipitate region soon disappears and subsequently the profusely branched root-like holdfast arises from the base of the blade. The blade becomes markedly furled and often deeply dissected (especially in surf-swept regions). The plant is 30–150 cm. long and up to 80 cm. wide. The surface of the blade is densely bullate, except near the base, where it is smooth (in surf-swept regions it may be completely smooth).

Habitat.—On rocks in the middle and lower intertidal and upper subtidal zones.

Pacific Coast Distribution.—Alaska to California.

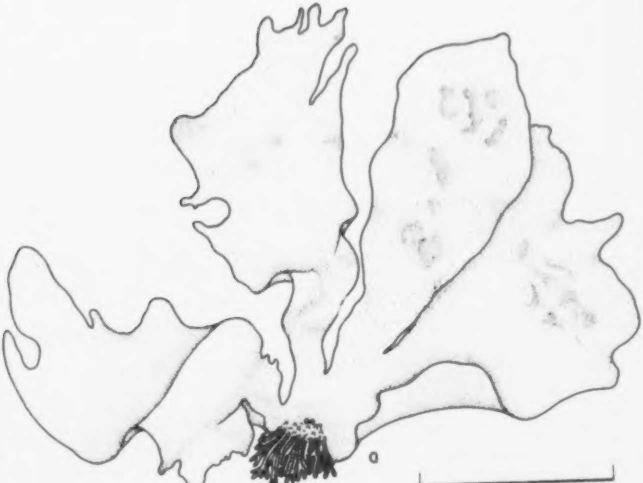


Fig. 54. *Hedophyllum sessile* (C. Agardh) Setchell. *a*, Habit of plant, showing deeply dissected characteristic, ruffled surfaces, and dense cluster of narrow root-like attachment structures.

DICTYONEURUM Ruprecht

Only one species, *Dictyoneurum californicum* Ruprecht, which is described and illustrated here, is recorded for this genus from British Columbia.

Dictyoneurum californicum Ruprecht

Description.—The young plant has a short stipe with a branched root-like holdfast; the holdfast soon disappears as the stipe becomes prostrate and develops into a conspicuous rhizome (Fig. 55*a*) with marginal root-like outgrowths. At the growing tip a blade-like erect portion develops. The base of the blade and tip of the prostrate region divide dichotomously, resulting in additional erect blades as the prostrate rhizome continues to develop. The erect blade-like portions are linear (Fig. 55*b*), tapering gradually to the base, are up to 60 cm. long and 18 cm. wide, rigid and somewhat brittle, and yellowish brown in colour. The margins of the blade are smooth or sometimes with short spine-like extensions, and the surfaces are reticulate (Fig. 55*a*) with coarse ribs.

Habitat.—On rocks in the lower intertidal and upper subtidal zones.

Pacific Coast Distribution.—British Columbia to California.

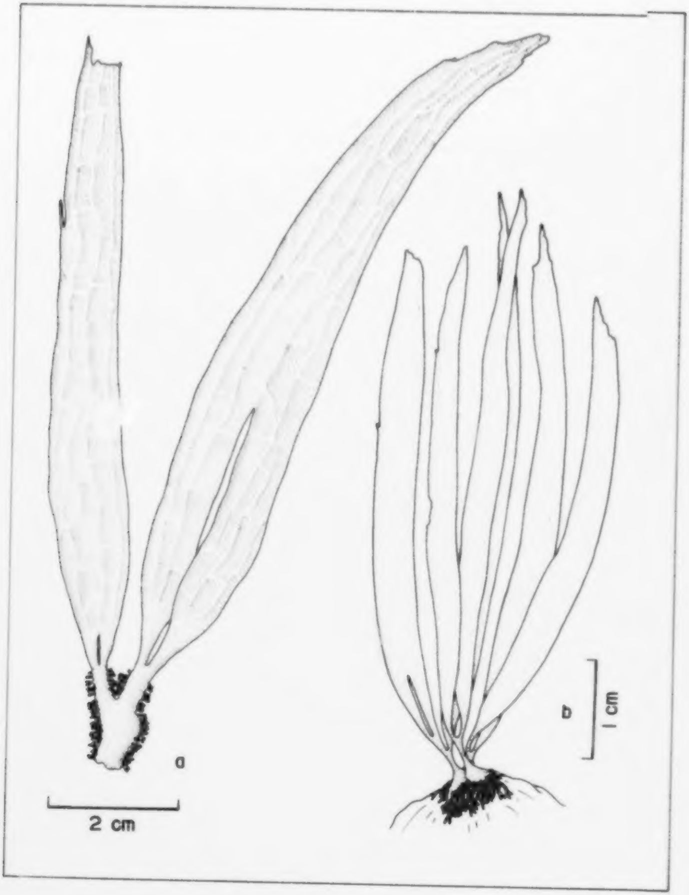


Fig. 55. *Dictyoneurum californicum* Ruprecht. *a*, Habit, showing plants attached to substrate; *b*, habit of a single plant, showing reticulate characteristics on blade and basal rhizome with root-like attachment structures.

NEREOCYSTIS Postels and Ruprecht

Nereocystis luetkeana (Mertens) Postels and Ruprecht, which is described and illustrated here, is the only species of this genus recorded from British Columbia.

Nereocystis luetkeana (Mertens) Postels and Ruprecht

Description.—The plant (Fig. 56*a*) is one of the largest brown algæ. It is attached by a stout holdfast of profusely branched root-like structures. From this a long stipe, up to 25 m. long, arises; it is narrow, cylindrical, and solid below, from 1 to 1.5 cm. in diameter, gradually increasing in diameter above and becoming a hollow tube terminating in an enlarged spherical float 15–17 cm. in diameter. From the surface of the float two clusters of flat dichotomously divided blades arise. There are up to 20 blades in each cluster. The blades are linear, 6–15 cm. broad and up to 4.5 m. long, tapering gradually to the attachment region.

Habitat.—On rocks in the upper subtidal zone and to a depth of several fathoms.

Pacific Coast Distribution.—Alaska to California.

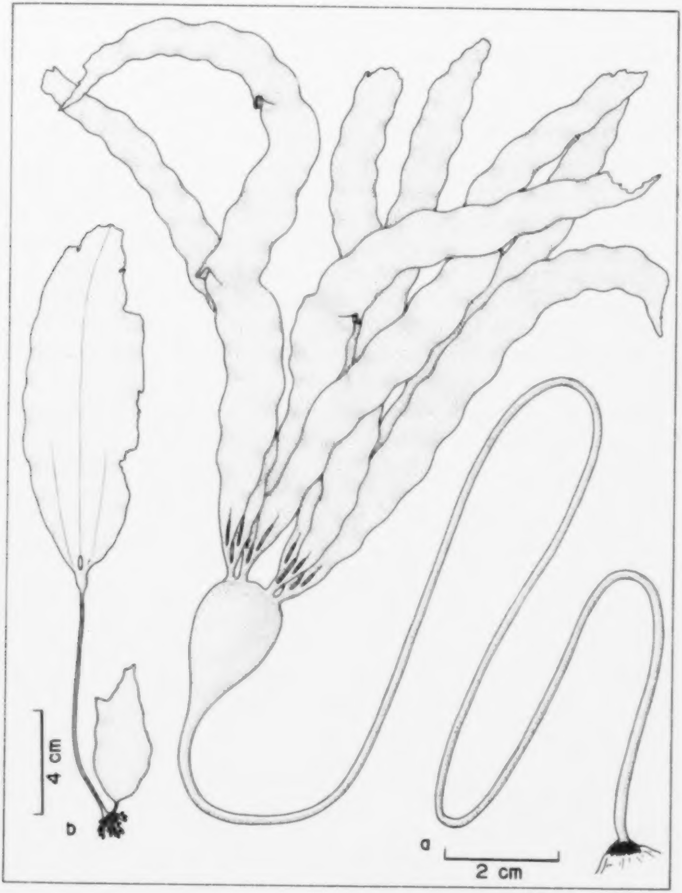


Fig. 56. *Nereocystis luetkeana* (Mertens) Postels and Ruprecht. *a*, Habit of two juvenile plants; *b*, habit of a mature plant showing attachment to substrate.

POSTELSIA Ruprecht

Postelsia palmæformis Ruprecht, which is described and illustrated here, is the only species of the genus recorded from British Columbia.

Postelsia palmæformis Ruprecht

Description.—The plant, which resembles a small palm-tree (Fig. 57*a*), is a rich olive-brown colour, up to 60 cm. high. The holdfast is made up of short, stout branched root-like structures from which a large, rigid cylindrical hollow stipe arises. The stipe is 1.5 to 3 cm. in diameter, tapering slightly upward, and bears a group (100–150) of falcate stipitate dichotomously branched blades, 15–24 cm. long and 3 cm. wide, at its summit. The flattened blades are covered on both surfaces with deep parallel longitudinal grooves.

Habitat.—On rocks in the middle and lower intertidal zones in areas exposed to heavy surf.

Pacific Coast Distribution.—British Columbia to California.

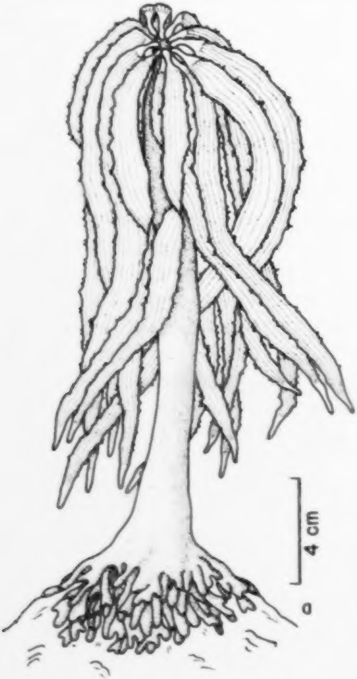


Fig. 57. *Postelsia palmæformis* Ruprecht. *a*, Habit of plant showing stout root-like base attached to substrate.

MACROCYSTIS C. Agardh

Macrocystis integrifolia Bory, which is described and illustrated here, is the only species of this genus recorded from British Columbia.

Macrocystis integrifolia Bory

Description.—The plant (Fig. 58*a*) is one of the largest brown algæ, and is deep brown in colour. It has a flattened, ligulate creeping rhizome, 2–4 cm. wide. The rhizome is profusely and dichotomously branched, attached closely to the substrate by branched root-like structures which arise from the margins (Fig. 58*a*). Numerous erect main stipes arise from the rhizome; they are slender, up to 1 cm. in diameter and up to 30 m. long. Leaf-like branches (Fig. 58*b*) arise at intervals along the stipe; they are flattened, 25–35 cm. long and up to 5 cm. wide with irregularly furrowed surfaces, tapering gradually to the end and abruptly rounded at the base to a spherical to oval float at the point of attachment on the stipe. The blades are denticulate along the margins. The terminal blade (Fig. 58*c*), located at the apex of the stipe, is split from the base with several new leaf-like branches in various stages of separation.

Habitat.—On rocks in the lowermost intertidal and upper subtidal zones to a depth of about 4 fathoms; only in areas close to the open ocean, but not exposed directly to heavy surf.

Pacific Coast Distribution.—Alaska to California.

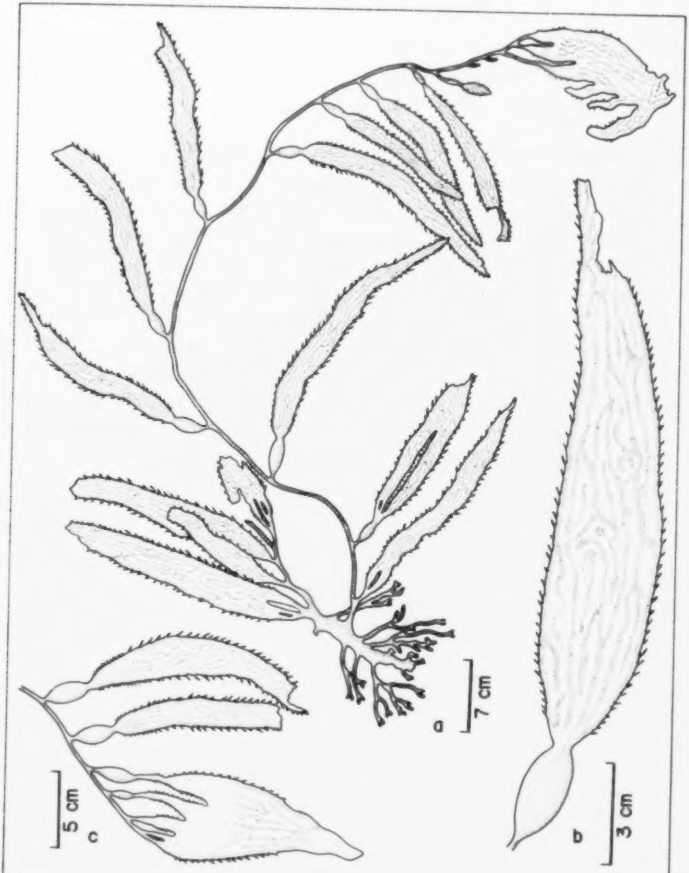


Fig. 58. *Macrocystis integrifolia* Bory. *a,* Habit of plant, showing root-like structures and erect branches with leaf-like blades; *b,* a single blade-like branch, showing corrugated surface and proximal float; *c,* distal portion of erect branch showing origin of new blades.

LESSONIOPSIS Reinke

Lessoniopsis littoralis (Farlow and Setchell) Reinke, which is described and illustrated here, is the only species of this genus recorded from British Columbia.

Lessoniopsis littoralis (Farlow and Setchell) Reinke

Description.—The plant (Fig. 59*a*) is olive green to dark brown in colour, up to 2 m. high, and differentiated into a holdfast, stipe, and blades. The holdfast is composed of short root-like structures; the stipe is woody, rigid, up to 20 cm. thick and 40 cm. long, with deep furrows. The plant is dichotomously branched at the top of the stipe, resulting in profuse linear blades 7–12 mm. wide and up to 80 cm. long. A percurrent midrib, 1–2 mm. wide, runs the length of the blades and merges into the stipitate basal portion of the blade.

Habitat.—On rocks in the lowermost intertidal zone in areas exposed to heavy surf on the open coast.

Pacific Coast Distribution.—Alaska to California.

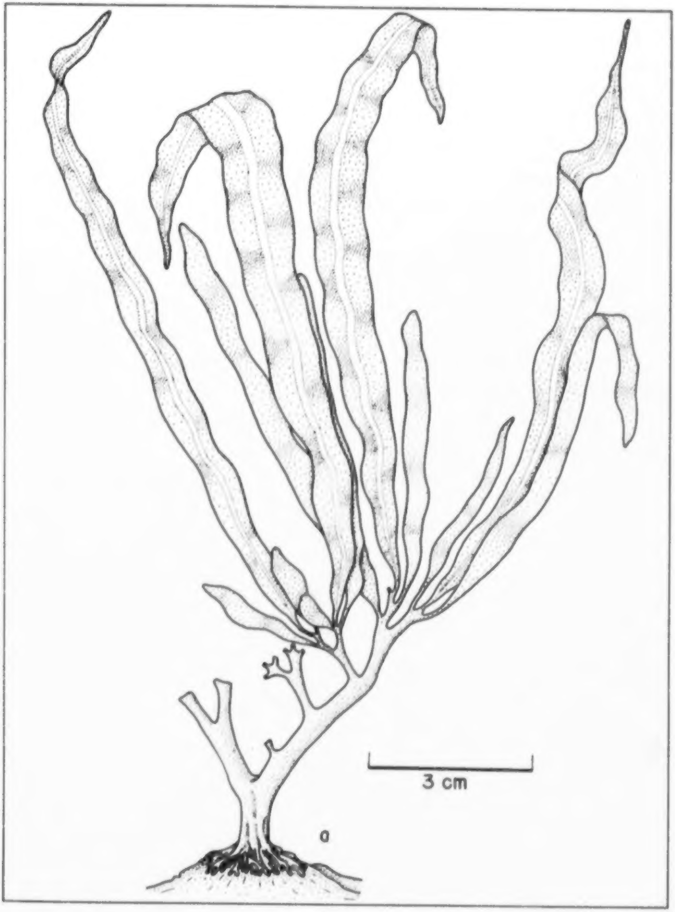


Fig. 59. *Lessoniopsis littoralis* (Farlow and Setchell) Reinke. *a*, Habit of plant, showing stout stipe attached to substrate and erect, flat blades.

PTERYGOPHORA Ruprecht

Pterygophora californica Ruprecht, which is described and illustrated here, is the only species of this genus recorded from British Columbia.

Pterygophora californica **Ruprecht**

Description.—The plant (Fig. 60*a*) has a large stout holdfast of branched root-like structures, and a woody stipe up to 2 m. long and 7 cm. in diameter. The stipe is terete below and flattened at the apex. A terminal flat, smooth blade arises from the apex of the stipe; it is linear, 6–10 cm. wide, 60–90 cm. long, and tapers in the attachment region. Sporophylls are pinnately arranged along the two sides of the flattened portion of the stipe. The sporophylls are linear, approximately the same shape and size as the terminal blade; up to 20 occur on each side.

Habitat.—On rocks in the upper subtidal zone and down to a depth of about 5 fathoms.

Pacific Coast Distribution.—British Columbia to Mexico.

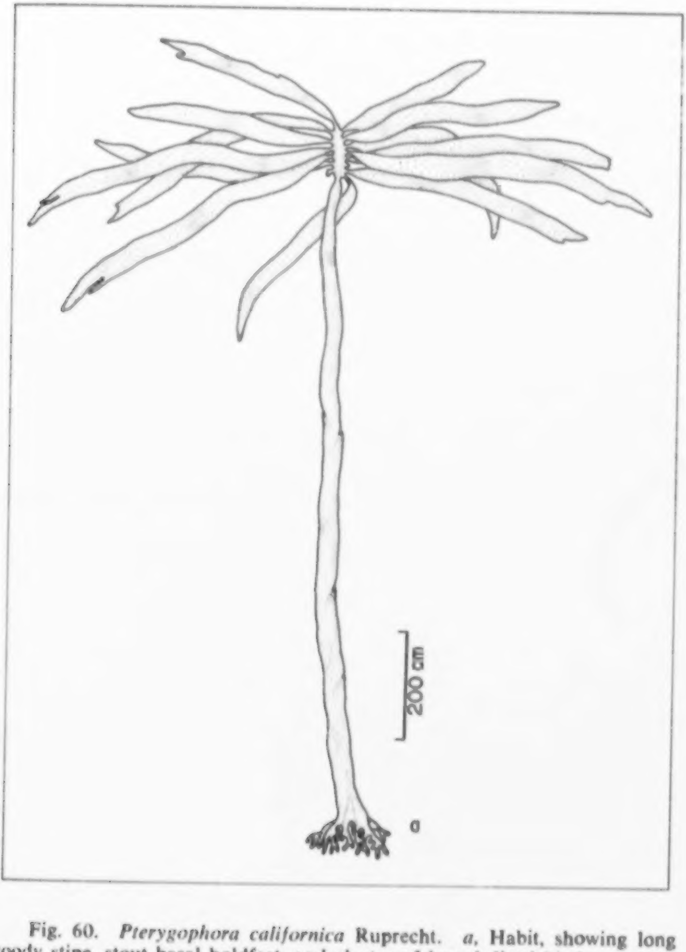


Fig. 60. *Pterygophora californica* Ruprecht. *a*, Habit, showing long woody stipe, stout basal holdfast, and cluster of broad distal blades.

ALARIA Greville

The genus *Alaria* is represented in British Columbia by several varieties in at least four species—*A. marginata* Postels and Ruprecht, *A. nana* Schrader, *A. tenuifolia* Setchell, and *A. valida* Kjellman and Setchell. Two of these species, *A. marginata* and *A. nana,* are described and illustrated here.

Alaria marginata Postels and Ruprecht

Description.—The plant is olive brown or rich brown in colour with a conspicuous blade, stipe, and holdfast. The holdfast is small and stout, composed of branched root-like structures. The stipe is cylindrical, about 3 mm. in diameter, 3–5 cm. long, merging into a flattened rachis which is about twice as wide as the stipe. The rachis in turn merges into the blade, which is linear, 15–20 cm. wide, 2.5–3 m. long, with a cuneate base, and has a prominent, solid percurrent midrib 5–22 mm. wide. Sporophylls (24–40 in number) arise from the margins of the rachis; they are lanceolate or elliptical, 2–3 cm. wide, 10–20 cm. long, and, when fertile, have a sorus covering both sides of the entire sporophyll.

Habitat.—On rocks in the lower intertidal and upper subtidal zones.

Pacific Coast Distribution.—Alaska to California.

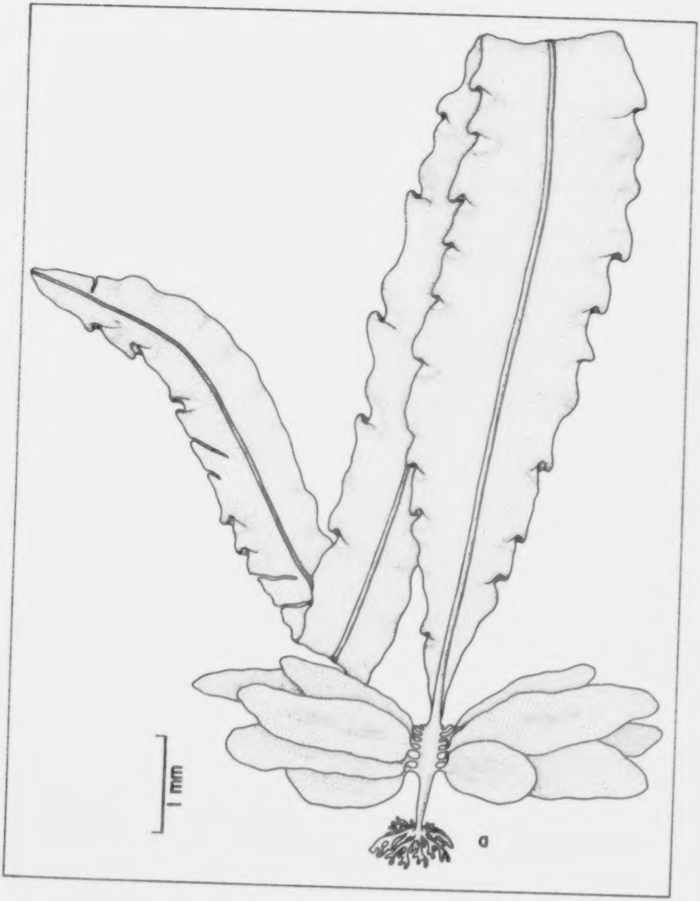


Fig. 61. *Alaria marginata* Postels and Ruprecht. *a*, Habit of plant, showing cluster of basal sporophylls, ruffled blade, and median midrib.

Alaria nana **Schrader**

Description.—The plant is olive brown to yellowish brown in colour with a conspicuous blade (eroded at maturity), stipe, and holdfast (Fig. 62*a*). The holdfast is made up of short, firm rootlike structures. The stipe is 3–7 cm. long, 5–8 mm. in diameter, merging into a slightly compressed rachis 2–4 cm. long. The rachis in turn merges into the blade, which is linear, tapering gradually to the apex and abruptly to the rachis; the blade is 40–60 cm. long and 3–8 cm. wide with a conspicuous, solid percurrent midrib 4–6 mm. wide. Sporophylls (25–50 in number) arise from the margins of the rachis; they are elliptical, 6–12 cm. long and 8–15 mm. wide, rounded at the distal end, and tapered to a stipitate attachment region. When fertile, sori are broadly elliptical and occur on both surfaces, but do not extend to the end of the sporophylls.

Habitat.—On rocks in the middle and upper intertidal zones in exposed areas.

Pacific Coast Distribution.—Alaska to California.

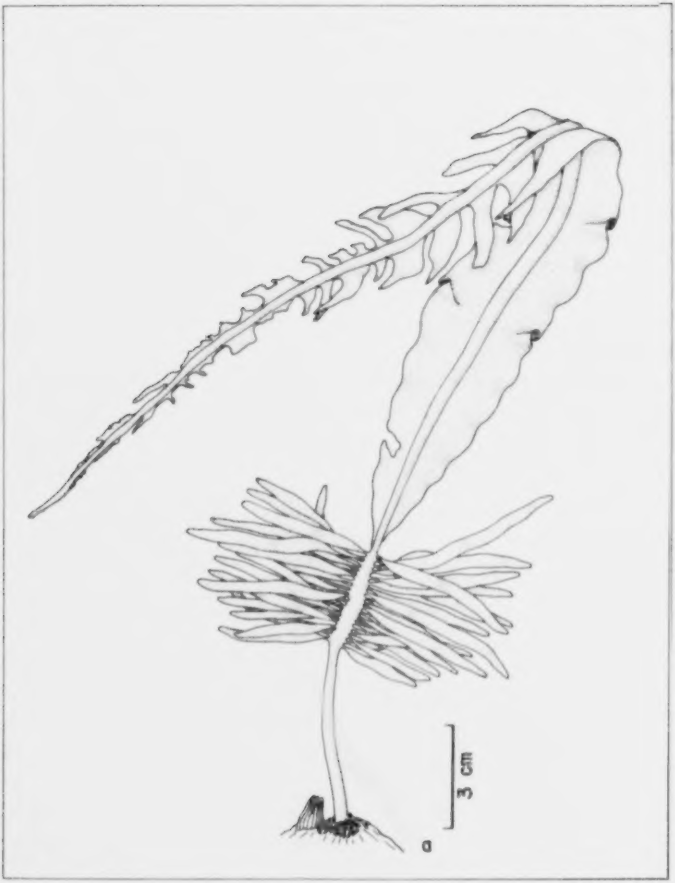


Fig. 62. *Alaria nana* Schrader. *a*, Habit, showing densely clustered basal sporophylls, lacerated distal region, and stout median midrib.

EISENIA Areschoug

Eisenia arborea Areschoug, which is described and illustrated here, is the only species of the genus recorded from British Columbia.

Eisenia arborea **Areschoug**

Description.—The plant (Fig. 63*a*) is dark brown, up to 1 m. high, with a profusely branched root-like holdfast. The stipe is tough and woody, terete near the holdfast, becoming flat and bifurcate above, each dichotomy terminating in a cluster of leaf-like blades. The blades are linear, tapering to the apex and to the stipitate base. The blades are deeply and irregularly furrowed with dentate margins, up to 60 cm. long and 5 cm. broad.

Habitat.—On rocks in the upper subtidal zone and to a depth of several fathoms.

Pacific Coast Distribution.—British Columbia to California.

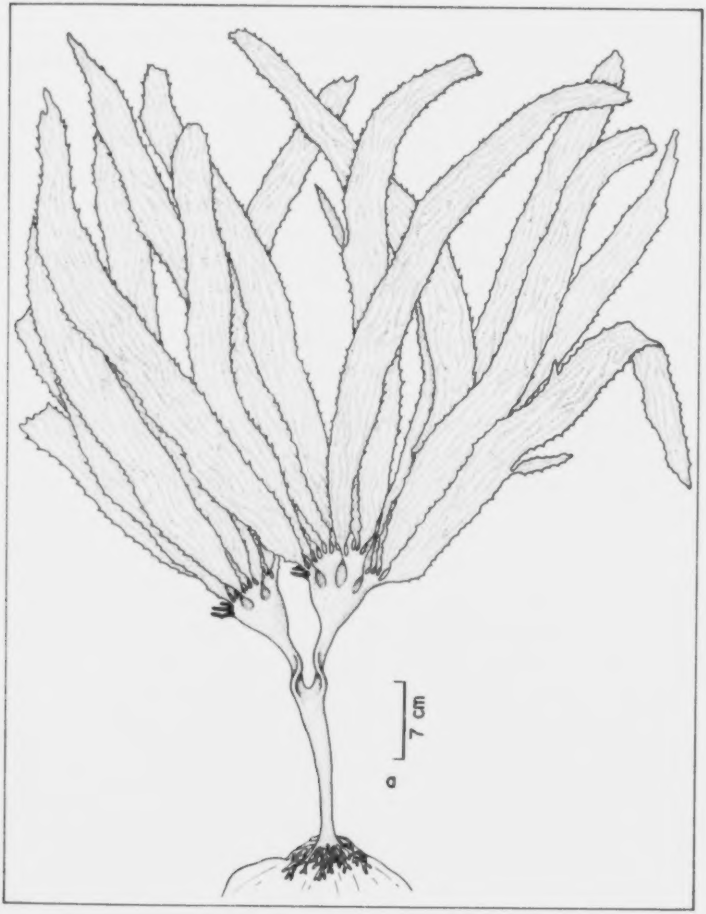


Fig. 63. *Eisenia arborea* Areschoug. *a*, Habit of plant attached to substrate, showing stout branched stipe and dense clustered corrugated distal blades.

EGREGIA Areschoug

Egregia menziesii (Turner) Areschoug, which is described and illustrated here, is the only species of the genus recorded from British Columbia.

Egregia menziesii (Turner) Areschoug

Description.—The plant is olive green to brown in colour with branches up to 10 m. long. The plant (Fig. 64*a*) is fastened by a compact mass of branched root-like structures. The stipe is irregularly branched near the base, terete below, and becoming ligulate above, 25–35 cm. wide, with numerous outgrowths along the margins throughout the length. Some of the outgrowths are flat and spatulate, others metamorphose into spherical to ellipsoidal floats (Fig. 64*b*). The surfaces of the ligulate region are densely covered with short blunt tubercles.

Habitat.—On rocks in the lower intertidal and upper subtidal zones in fairly exposed areas.

Pacific Coast Distribution.—British Columbia to California.

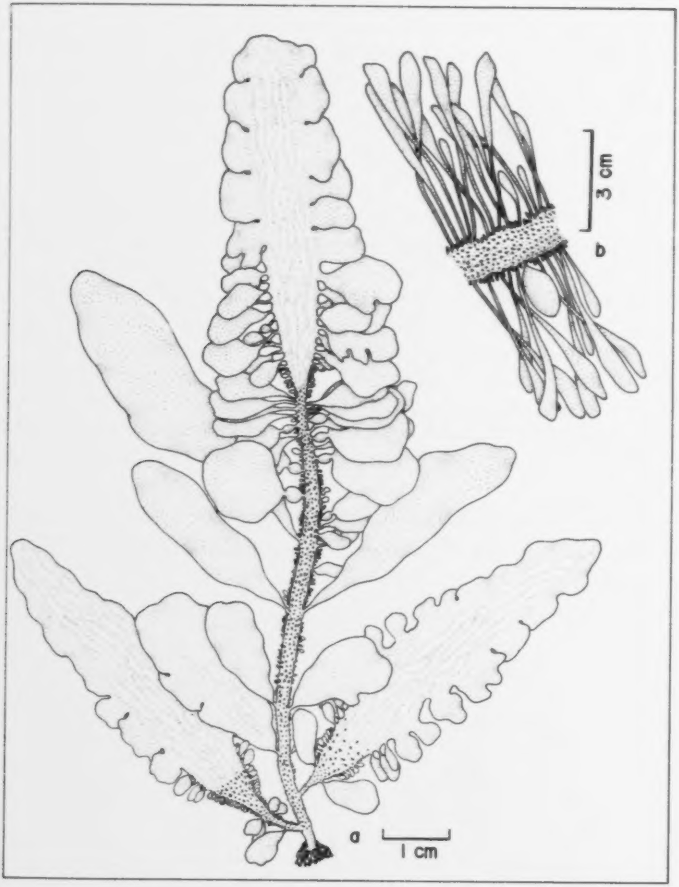


Fig. 64. *Egregia menziesii* (Turner) Areschoug. *a*, Habit of juvenile plant; *b*, habit of a portion of the axis, showing marginal blades and spherical float.

FUCUS L.

The genus *Fucus* is represented in British Columbia by a number of poorly demarcated varieties in four species—*F. edentatus* De la Pylaie, *F. evanescens* C. Agardh, *F. gardneri* Silva, and *F. membranaceus* Gardner. Only one of these species, *F. gardneri*, is described and illustrated here.

***Fucus gardneri* Silva**

Description.—The plant (Fig. 65*a*) is erect, up to 50 cm. high, somewhat rigid and cartilaginous, markedly flattened, and olive green to yellowish green in colour. The plant is regularly and repeatedy dichotomously branched, starting 2–5 cm. above a basal discoid holdfast. There is a conspicuous percurrent midrib throughout. The erect flattened portion is 10–18 mm. wide, and near the holdfast the plant becomes narrowly stipitate through thickening of the midrib and erosion of the thinner margins. The apices of the plant are broadly rounded, with swollen receptacles (when sexually mature) up to 6 cm. long. The swollen tips are generally yellowish in colour.

Habitat.—On rocks in the middle and lower intertidal zones.

Pacific Coast Distribution.—Alaska to California.

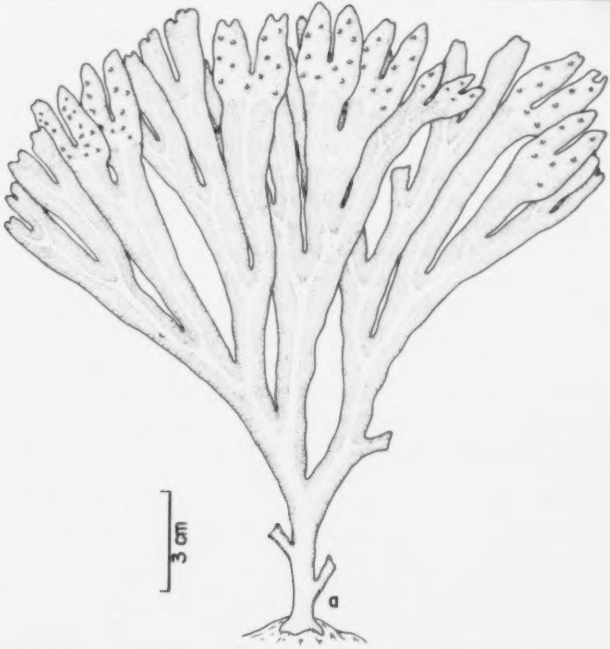


Fig. 65. *Fucus gardneri* Silva. *a*, Habit of dichotomously branched plant attached to substrate, showing conspicuous midrib and swollen receptacles.

PELVETIOPSIS Gardner

Pelvetiopsis limitata (Setchell) Gardner, which is described and illustrated here, is the only species of this genus recorded from British Columbia.

***Pelvetiopsis limitata* (Setchell) Gardner**

Description.—The plant (Fig. 66*a*), which is olive green to light tan in colour, is 8–18 cm. tall and confined to the high intertidal region in exposed areas of the coast. The holdfast is discoid, confluent, with several erect axes appearing to arise from the same holdfast. The plant is flattened above, up to 4 mm. broad, 3–5 times dichotomously divided, often contorted, and devoid of a midrib. It is cylindrical near the base. The apices are tapered or blunt with swollen receptacles, 5–10 mm. long, at maturity (Fig. 66*b*).

Habitat.—On rocks in the extreme upper intertidal zone on exposed regions of the open coast.

Pacific Coast Distribution.—British Columbia to California.

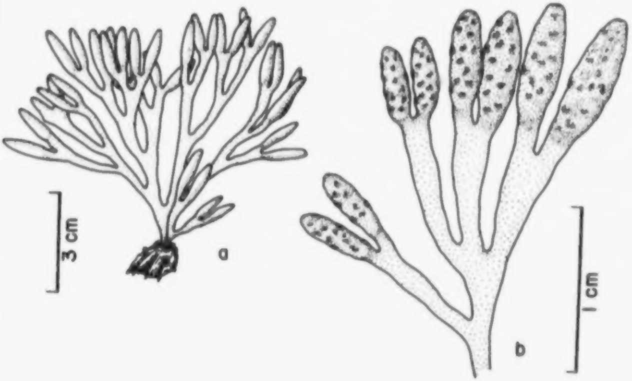


Fig. 66. *Pelvetiopsis limitata* (Setchell) Gardner. *a*, Habit of dichotomously branched plant attached to a barnacle; *b*, distal portion of plant showing branching habit and swollen apical receptacles.

CYSTOSEIRA C. Agardh

Cystoseira geminata C. Agardh, which is described and illustrated here, is the only species of the genus recorded from British Columbia.

Cystoseira geminata **C. Agardh**

Description.—The plant (Fig. 67*a*) is profusely branched, yellowish brown to dark brown in colour, reaching a height of 2–5 m. The plant is fastened to the substrate by a stout discoid holdfast (Fig. 67*a*). A short, stout terete stipe arises from the holdfast. This stipe is soon dissected into a number of stout radially arranged primary branches which in turn bear long filiform secondary branches. The long filiform branches produce shorter alternately arranged tertiary branchlets. Near the base these tertiary branchlets undergo a few divisions, become markedly flattened and leaflike, and give the basal region of the plant the appearance of a fern frond. These flattened branchlets are short, lanceolate in shape, with smooth margins, and are ribless. In the mature parts of the plant near the tips of the long filiform branches the branchlets are at first terete, giving rise to secondary and higher orders of branchlets. The ultimate branchlets have inflations, or air vesicles (Fig. 62*b*), borne singly or in pairs or chains. The vesicles are oval and always apiculate. Fertile branchlets are modified ultimate branchlets and frequently terminate in an apiculate air vesicle. The receptacles are long, thin, and somewhat flattened with a warty appearance (Fig. 67*c*).

Habitat.—On rocks in the lower intertidal and upper subtidal zones.

Pacific Coast Distribution.—Bering Sea to Washington.

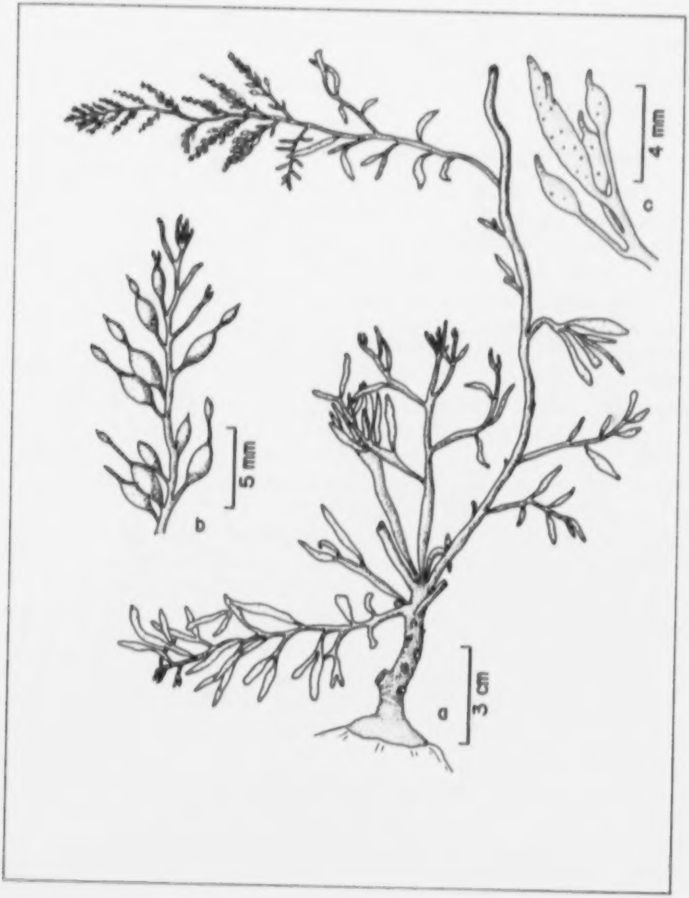


Fig. 67. *Cystoseira geminata* C. Agardh. *a*, Habit of plant, showing stout conical holdfast and branching habit; *b*, enlarged view of a portion of a plant showing vesicles in short chains; *c*, enlarged view of a portion of a plant showing swollen fertile receptacle.

SARGASSUM C. Agardh

Sargassum muticum (Yendo) Fensholt, which is described and illustrated here, is the only species of this genus recorded from British Columbia.

Sargassum muticum (Yendo) Fensholt

Description.—The plant (Fig. 68*a*) is profusely branched, yellowish brown in colour, up to 2 m. high. The plant is fastened to the substrate by a stout discoid holdfast (Fig. 68*a*). A short terete stipe or stalk arises from the holdfast. The stipe is soon dissected into a number of fasciculate primary branches which in turn bear long filiform secondary branches. The long filiform branches produce shorter alternately arranged tertiary and higher orders of branchlets. Near the base of the plant these branchlets are flattened, long and narrow, tapering toward the attachment and rounded at the apex. They have an irregularly dentate or serrate margin and a conspicuous midrib. In the mature parts (Fig. 68*d*) of the plant and near the tips of the long filiform branches, the branchlets are at first terete or rounded and then ultimately either flattened, transformed into a vesicle (Fig. 68*a*), or modified into a swollen receptacle (Fig. 68*c*). The flattened ultimate branchlets are rather similar to the broad basal branchlets, but are smaller, shorter, and more conspicuously and irregularly dentate on the margins and less conspicuously ribbed. The vesicles (Fig. 68*d*) are stalked, borne singly, and never apiculate. They are spherical to pyriform in shape. The fertile receptacles are long and terete (Fig. 68*b, c*).

Habitat.—On rocks in the lower intertidal and upper subtidal zones.

Pacific Coast Distribution.—British Columbia to Oregon.

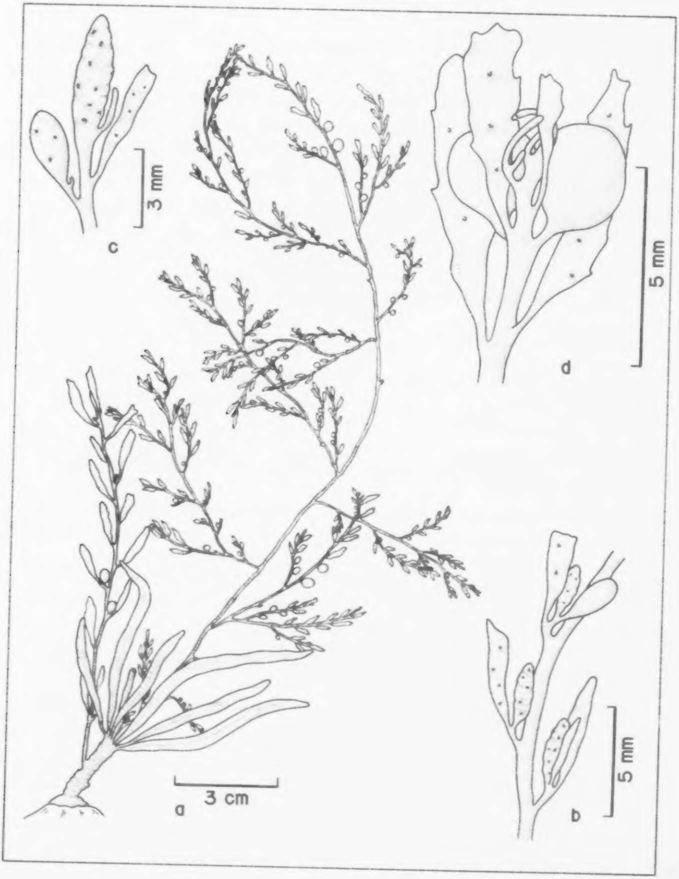


Fig. 68. *Sargassum muticum* (Yendo) Fensholt. *a*, Habit of plant, showing conical holdfast attached to substrate and branching habit; *b*, enlarged view of a portion of the plant showing fertile receptacles; *c*. enlarged view of a portion of the plant showing swollen receptacles; *d*, enlarged view of a portion of the plant showing spherical vesicles.

CLASS RHODOPHYCEÆ (RED ALGÆ)

There are 112 genera of red algæ and more than 260 species (including forms and varieties) that occur in British Columbia. Of these, 34 of the most common genera are described and illustrated by one species and 17 are described and illustrated by more than one species where there are morphologically diverse species within the genus. Altogether, 51 genera of red algæ with a total of 70 species are described and illustrated in the following pages. A key to the genera of red algæ included in this guide appears below.

KEY TO GENERA OF RHODOPHYCEÆ (RED ALGÆ)

PAGE

1. Plant calcareous (lime-encrusted), erect, jointed, and rigid—2.
1. Plant not calcareous—4.
   2. Swollen tetrasporangiate conceptacles restricted usually to terminal joints of erect branches; branching wholly or partially pinnate—CORALLINA 200
   2. Swollen tetrasporangiate conceptacles, usually lateral on the margins or the flattened faces of the segments of erect branches —3.
3. Medullary filaments of intersegmental region straight—BOSSIELLA 196
3. Medullary filaments of intersegmental region flexuous and interlacing—CALLIARTHRON 202
   4. Plant at maturity a simple or branched, uniseriate (or sometimes multiseriate) filament, sometimes becoming polysiphonous or developing a cortex in the mature parts—5.
   4. Plant at maturity always more than one cell broad, usually organized into a complex erect simple or branched multicellular body—10.
5. Filaments unbranched, uniseriate near the base, becoming multiseriate in older parts by a few longitudinal cell divisions—BANGIA 172
5. Filaments branched—6.
   6. Branches uncorticated, not polysiphonous; cells of major axes with opposite branchlets or with a verticil of three or four branchlets—ANTITHAMNION 268
   6. Branches corticated or polysiphonous (sometimes both)—7.
7. Branches polysiphonous (with cells in regular tiers)—8.
7. Branches not polysiphonous, generally partially corticated or corticated throughout—9.
   8. Branches cylindrical, with trichoblasts and scar cells present—POLYSIPHONIA 300
   8. Branches slightly to markedly flattened; trichoblasts and scar cells lacking—PTEROSIPHONIA 302

Page

9. Plants with regularly alternate branching, generally corticated uniformly throughout or only in basal portion of plant—Callithamnion 270

9. Plant usually more or less dichotomously branched; branches with forcipate tips, with a uniseriate axis of large cells covered at regular intervals with bands of small cortical cells (or sometimes with axial cells completely covered by a continuous layer of cortical cells—Ceramium 272

10. Plant with main axes terete, cylindrical, or sometimes slightly flattened, or a hollow sac, branched or unbranched—11.

10. Plant neither terete nor cylindrical nor a slightly flattened cylinder (sometimes markedly flattened and blade-like), branched or unbranched—31.

11. Branches terminating in swollen vesicular apices filled with a slimy secretion—Botryocladia 258

11. Branches not terminating in swollen vesicles—12.

12. Plant branched or unbranched with a solid stipe with each branch apex terminating in a single flat, perfoliate circular blade —Constantinea 192

12. Plant not with flat circular perfoliate blades—13.

13. Plant a hollow sac, usually simple, with numerous fine pores opening into the water-filled sac—Halosaccion 260

13. Plant not a hollow sac—14.

14. Plant with main axes bearing transverse whorls of short simple branchlets at intervals; gelatinous in texture—Gloiosiphonia 206

14. Plant not with transverse whorls of branchlets—15.

15. Plant with main axes bearing numerous short branchlets which are transversely septate and constricted at intervals—Gastroclonium 266

15. Plant not with transversely septate constricted branchlets—16.

16. Plant solid, smooth, usually unbranched, slimy, composed of a solid mass of loosely branched filaments, with those in the centre arranged in a more or less distinct compact medulla of longitudinal filaments—Nemalion 178

16. Plant not composed of a solid mass of loosely branched filaments—17.

17. Plant slightly compressed, branching distichous, and repeatedly pectinate, with unilateral narrow branches—18.

17. Branching not pectinate—19.

18. Branches generally incurved toward the apex—Plocamium 230

18. Branches generally curved away from the apex; apex of branches somewhat forcipate—Microcladia 276

19. Plant with branching conspicuously dichotomous, but limited to only a few orders of branching—21.

PAGE

19. Plant not conspicuously dichotomously branched—20.

20. Plant tough and wiry in texture; medulla of compact narrow parallel longitudinal filaments—AHNFELTIA 234

20. Plant soft and somewhat gelatinous when wet; medulla loosely filamentous with a single axial filament—GLOIOPELTIS 210

21. Plant with short branchlets spirally arranged (may be distichous in distal region), polysiphonous in organization, although obscured in mature parts as a result of well-developed cortex—22.

21. Plant not polysiphonous in organization—23.

22. Plant cylindrical to slightly compressed, branching radial, with a few long major axes from which arise numerous short branchlets, apices of branchlets rounded—RHODOMELA 308

22. Plant with several orders of branches alternately arranged, cylindrical usually only near the base, compressed slightly above and distichous, apices of branchlets acutely pointed—ODONTHALIA 310

23. Plant soft and gelatinous, unbranched or with a few main axes densely clothed on all sides with short branchlets of much shorter diameter than the main axes, sometimes somewhat flattened—CUMAGLOIA 180

23. Plant not soft and gelatinous—24.

24. Plant firm and rigid with a few main axes bearing many short branchlets all about the same length and with rounded apices; medulla loosely organized with a single axial filament—CRYPTOSIPHONIA 188

24. Plant not having medulla with single axial filament—25.

25. Plant with branches bearing numerous short spiny branchlets—ENDOCLADIA 208

25. Plant not with short spiny branchlets—26.

26. Plant firm and wiry in texture, cylindrical or slightly flattened, branchlets opposite or alternate and constricted at the base—GELIDIUM 184

26. Branchlets not constricted at the base—27.

27. Medulla a compact mass of dense interwoven filaments, cortex small-celled—AGARDHIELLA 226

27. Medulla not of interwoven filaments—28.

28. Medulla large-celled, with cortex of progressively smaller cells toward the surface—GRACILARIOPSIS 232

28. Medulla not large celled—29.

29. Plant profusely and alternately branched, with numerous short branchlets all about the same length arranged distichously; branchlets terminating in monosiphonous filaments—RHODOPTILUM 298

29. Branching not with numerous short branchlets, all about the same length and not terminating in monosiphonous filaments; plant distichously branched with two branches of a pair dissimilar—30.

PAGE

30. One of each pair of branches much longer than the opposite branch, markedly compressed and resembling minute leaflets in the ultimate branches—PTILOTA 280

30. One of each pair of branches short and spine-like, the other long and with one or more orders of branchlets; branches cylindrical or very slightly compressed—BONNEMAISONIA 182

31. Plant monostromatic or distromatic, usually an undivided broad flat blade, although sometimes deeply split, without protoplasmic continuity between adjacent cells and without veins or midrib—32.

31. Plant usually several to many cells in thickness, branched or unbranched, with or without midrib or veins, with protoplasmic continuity between adjacent cells—33.

32. Plant small, monostromatic, growing epiphytically in small tufts attached by a cushion-like base to leaves of *Zostera* or *Phyllospadix*—SMITHORA 176

32. Plant large, monostromatic or distromatic, attached to the substrate by a small discoid rhizoidal holdfast—PORPHYRA 174

33. Plant a single, broad, flat undivided (sometimes lacerated) blade, although in some instances with small proliferous blades from the margin or surface, sessile or with a distinct stipe—34.

33. Plant distinctly flattened, more or less divided and in some instances regularly branched—41.

34. Plant when mature with surfaces of blade covered with small papillate outgrowths; medulla of intertwined colourless filaments—GIGARTINA 244

34. Plant not with papillate outgrowths—35.

35. Plant when mature with numerous perforations; medulla of large cubical cells—RHODYMENIA 262

35. Blade not perforate—36.

36. Plant with a network of conspicuous somewhat emergent anastomosing veins—POLYNEURA 290

36. Plant without conspicuous veins—37.

37. Plant very slippery, brownish red in colour, with conspicuous gland cells in the outer cortex near the surface—SCHIZYMENIA 224

37. Plant lacking gland cells—38.

38. Blade fairly thick and tough, usually iridescent, with a pronounced cylindrical to flattened stipe; medulla filamentous—IRIDÆA 254

38. Blade not thick and iridescent—39.

39. Blade thin, purplish in colour—RHODOGLOSSUM 250

39. Blade not purplish in colour—40.

40. Blade brownish black in colour, narrowly stipitate at base; medulla of compact intertwined filaments—DILSEA 190

40. Blade usually somewhat flaccid and gelatinous, dull red to brownish red in colour, sometimes branched with numerous

PAGE

proliferous bladelets from the margins; medulla of colourless stellate cells with long filamentous processes—GRATELOUPIA 212

41. Plant thick and cartilaginous, blood red in colour, with a small undivided rounded smooth stipitate flattened primary blade giving rise to proliferous stipitate blades of the same size or larger from the margins of the primary blade; cortex with numerous large gland cells near the surface—OPUNTIELLA 228

41. Plant not thick, without rounded proliferous branches from margins and without gland cells—42.

  42. Plant more or less dichotomously divided in main axes; sometimes appearing flabellately divided when mature (in upper branches sometimes producing proliferous blades)—43.

  42. Plant not dichotomously divided—54.

43. Plant when mature with surfaces of blade covered with small papillate outgrowths; medulla of intertwined colourless filaments—GIGARTINA 244

43. Plant not with papillate outgrowths—44.

  44. Plant divided into a few broad orders of branching, usually with numerous proliferous branchlets; medulla of large cubical cells —RHODYMENIA 262

  44. Plant not as above—45.

45. Plant thick and horny, brownish black in colour; medulla composed of angular cells—GYMNOGONGRUS 238

45. Plant not thick and horny—46.

  46. Plant repeatedly and regularly branched into several orders of branching, progressively narrower from base to apex; branches with blunt apices; texture somewhat rubbery—RHODOGLOSSUM 250

  46. Plant not as above, not rubbery in texture—47.

47. Plant not membranous; flabellately divided into progressively narrower segments; medulla mostly of large cubical cells—CALLOPHYLLIS 218

47. Plant not flabellately divided—48.

  48. Branching restricted to a few dichotomies with linear segments and blunt apices; medulla of large cubical cells—STENOGRAMME 242

  48. Plant not with linear segments—49.

49. Plant with major axes approximately the same width throughout; ultimate branches frequently with numerous proliferous marginal, distichously arranged pinnate branchlets; medulla of intertwined colourless filaments—PRIONITIS 214

49. Plant thin and membranous, with a midrib or vein or both, usually rose red in colour—50.

  50. Plant with conspicuous midrib and with proliferous blades arising from midrib—DELESSERIA 288

  50. Plant not with proliferous blades arising from the midrib—51.

PAGE

51. Plant with conspicuous forked veins diagonal to a conspicuous midrib; medulla of longitudinal filaments; cortex of progressively smaller rounded cells toward the surface—ERYTHROPHYLLUM 222

51. Plant not with filamentous medulla; usually with monostromatic portions lateral to the midrib—52.

52. Plant with or without delicate veins from midrib, sometimes alternately or subdichotomously branched (occasionally with small proliferous blades from midrib)—MEMBRANOPTERA 286

52. Plant not as above, usually flabellately divided, sometimes with ruffled margins—53.

53. Blades with microscopic veins, margins usually without small proliferations; tetrasporangiate sori in linear or elliptical sori scattered over the entire blade—HYMENENA 292

53. Without percurrent midrib, but with midrib present in basal region of main axis; margins of blade ruffled, usually with small proliferations; macroscopic veins only on main axes; tetrasporangiate sori only along the margins of the branches or sometimes in small proliferations from the margins—CRYPTOPLEURA 296

54. Blade usually somewhat flaccid and gelatinous, dull red to brownish red in colour, sometimes branched with numerous proliferous bladelets from the margin; medulla of colourless stellate cells with long filamentous processes—GRATELOUPIA 212

54. Plant with main axes variously branched, with or without a midrib and veins—55.

55. Branching regularly pinnate; branch tips blunt, terminating in a small depression containing a single apical cell; evanescent trichoblasts formed at apices; cartilaginous in texture—LAURENCIA 306

55. Branching not regularly pinnate, not with apical depression or trichoblasts—56.

56. Plant with major branches approximately the same width throughout; ultimate branches frequently with numerous proliferous, marginal, distichously arranged pinnate branchlets —PRIONITIS 214

56. Plant thin and membranous with a midrib or veins or both, usually rose red in colour—57.

57. Plant with conspicuous midrib and with proliferous blades arising from the midrib—DELESSERIA 288

57. Plant not with proliferous blades arising from midrib—58.

58. Plant with conspicuous forked veins diagonal to a conspicuous midrib; medulla of longitudinal filaments; cortex of progressively smaller rounded cells toward the surface—ERYTHROPHYLLUM 222

58. Plant not with filamentous medulla; usually with monostromatic portions lateral to the midrib—59.

PAGE

59. Plant with or without delicate veins from midrib, sometimes alternately or subdichotomously branched (occasionally with small proliferous blades from the midrib)—MEMBRANOPTERA 286

59. Plant not as above, usually flabellately divided, sometimes with ruffled margins—60.

  60. Blades with microscopic veins, margins usually without small proliferations; tetrasporangiate sori in linear or elliptical sori scattered over the entire blade—HYMENENA 292

  60. Without percurrent midrib, but with midrib present in basal region of main axis; margins of blade ruffled, usually with small proliferations; macroscopic veins only on main axes; tetrasporangiate sori only along the margins of the branches or sometimes in small proliferations from the margins—CRYPTOPLEURA 296

BANGIA Lyngbye

Two species of the genus *Bangia*—*B. fuscopurpurea* (Dillwyn) Lyngbye and *B. tenuis* Gardner—are recorded from British Columbia. One of these, *B. fuscopurpurea,* is described and illustrated here.

***Bangia fuscopurpurea* (Dillwyn) Lyngbye**

Description.—The plant is erect (Fig. 69*a*), cylindrical, and unbranched. The filaments reach a length of 2–10 cm. tall. The filaments become densely matted and form rusty brown to almost black flattened masses adhering tightly to the substrate. When young, and in the basal region, the plant is uniseriate (Fig. 69*b*); later, and in the distal region, the cells divide repeatedly to produce a plant several cells broad (Fig. 69*c*). The basal cells develop rhizoidal extensions (Fig. 69*b*), which aggregate to form a small discoid holdfast attaching the plant to the substrate. In the uniseriate region the cells are short and broad; in the distal, multiseriate region they are angular to cubical and arranged in transverse rows. Each cell contains a single stellate chloroplast.

Habitat.—On old wood, piles, and rocks in the upper intertidal zone.

Pacific Coast Distribution.—Alaska to Costa Rica.

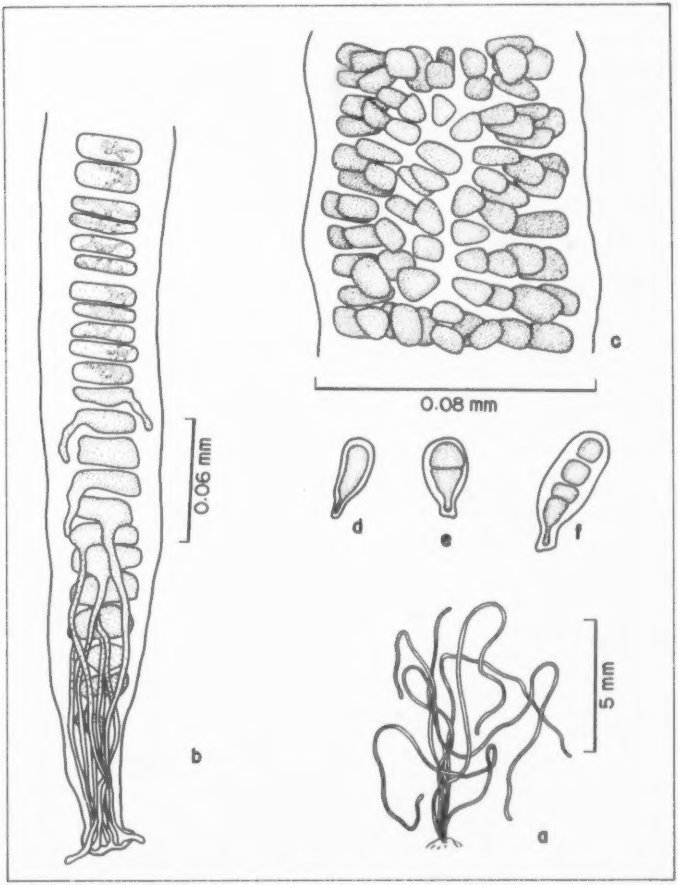


Fig. 69. *Bangia fuscopurpurea* (Dillwyn) Lyngbye. *a*, Habit of unbranched filamentous plant attached to substrate; *b*, view of basal region of plant showing rhizoidal basal cells; *c*, surface view of distal portion of plant; *d–f*, stages in development of juvenile plant.

PORPHYRA C. Agardh

The genus *Porphyra* is represented in British Columbia by seven species—*P. abyssicola* Kjellman, *P. amplissima* (Kjellman) Setchell and Hus, *P. lanceolata* (Setchell and Hus) G. M. Smith, *P. miniata* Setchell and Hus, *P. nereocystis* Anderson, *P. perforata* J. Agardh, and *P. umbilicalis* (Setchell and Gardner) Collins. One of these, *P. perforata*, is described and illustrated here. Some species are monostromatic and others are distromatic.

***Porphyra perforata* J. Agardh**

Description.—The plant (Fig. 70*a*) is a single thin membranous blade, at maturity becoming broad, irregularly lobed or laciniate, with deeply ruffled margins, and attached by a small discoid holdfast to the substrate. The plant is steel grey to brownish purple in colour and from 20–150 cm. tall. The blade is monostromatic (Fig. 70*b*), with the cells taller than broad as seen in transverse section. Each cell has a single stellate chloroplast.

Habitat.—On rocks and epiphytic on other algæ in the intertidal and upper subtidal zones.

Pacific Coast Distribution.—Alaska to Mexico.

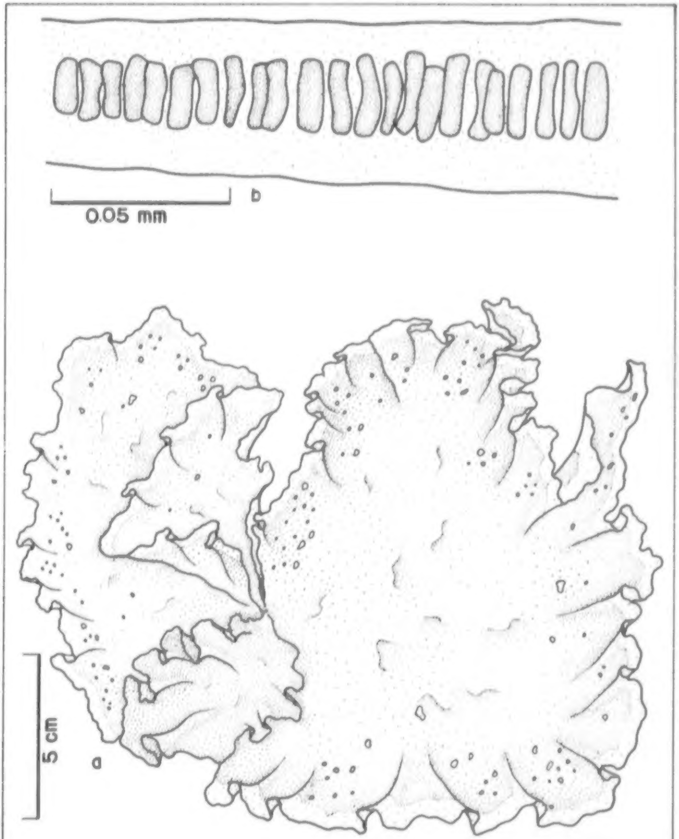


Fig. 70. *Porphyra perforata* J. Agardh. *a*, Habit of plant; *b*, transverse section of portion of plant showing monostromatic structure.

SMITHORA Hollenberg

Only one species of the genus *Smithora, S. naiadum* (Anderson) Hollenberg, which is described and illustrated here, is recorded from British Columbia.

Smithora naiadum **(Anderson) Hollenberg**

Description.—The plant (Fig. 71*b*) is a small epiphyte, 2–10 cm. high, with numerous elongate, stipitate, monostromatic (Fig. 71*d*) blades arising from a cushion-like base, attached to the margins of leaves of *Zostera* (Fig. 71*a*) and *Phyllospadix*. The plant is purplish red to a deep purple colour. The cushion-like base is a parenchymatous multicellular structure without rhizoids. Each cell contains a single stellate chloroplast.

Habitat.—Epiphytic on leaves of *Phyllospadix* and *Zostera*.

Pacific Coast Distribution.—Alaska to Mexico.

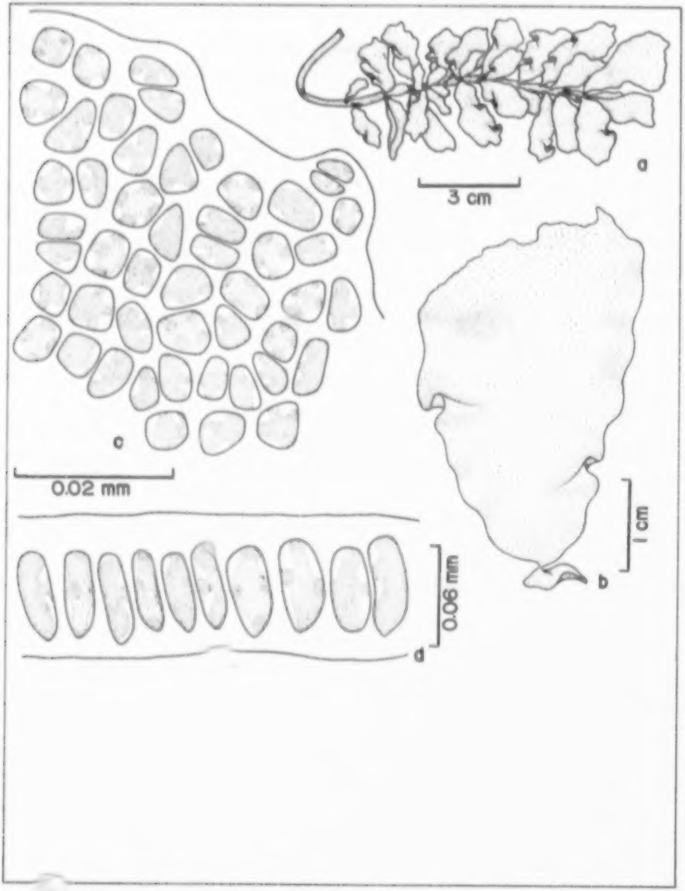


Fig. 71. *Smithora naiadum* (Anderson) Hollenberg. *a*, Habit of group of plants attached to margins of *Zostera;* *b*, habit of a single plant, showing cushion-like basal region; *c*, enlarged surface view showing arrangement of cells; *d*, transverse section of blade-like plant showing monostromatic structure.

NEMALION Targioni-Tozzetti

Only one species of the genus *Nemalion, N. elminthoides* (Velley) Batters, which is described and illustrated here, is recorded from British Columbia.

Nemalion elminthoides (Velley) Batters

Description.—The plant is erect, up to 30 cm. high, olive brown in colour, growing singly or in clusters (Fig. 72*a*) from a cushion-like discoid base. The erect portion is a solid, usually unbranched cylinder of a soft slimy texture, up to 6 mm. in diameter. The medulla is composed of narrow interwoven filaments (Fig 72*b*), which merge into somewhat broader branched filaments terminating at the surface.

Habitat.—On rocks in the middle and lower intertidal zones.

Pacific Coast Distribution.—Alaska to Mexico.

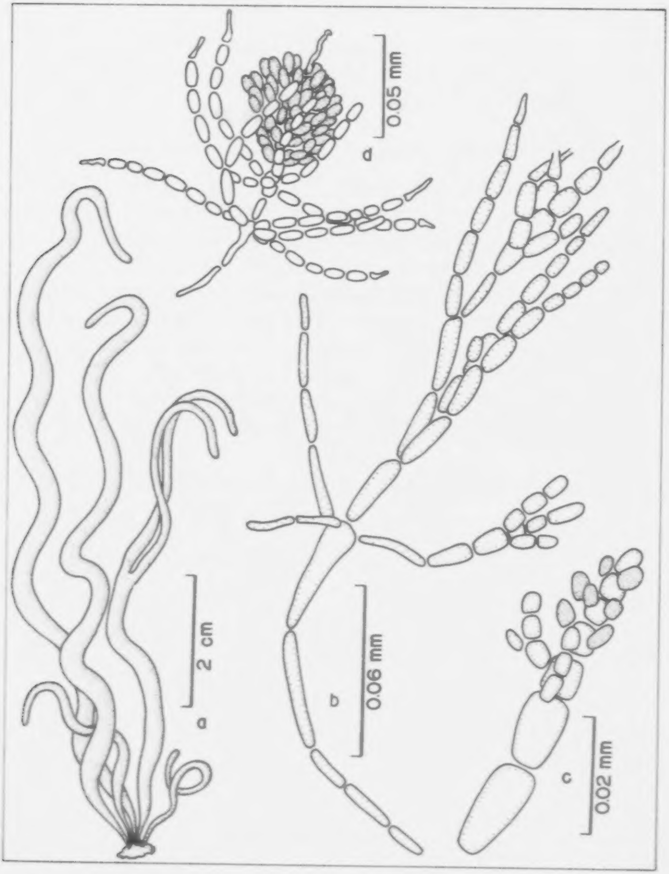


Fig. 72. *Nemalion elminthoides* (Velley) Batters. *a*, Habit showing cluster of plants arising from discoid base; *b*, enlarged vegetative portion of plant showing filamentous structure; *c*, enlarged portion of filament showing male reproductive structures (spermatangia); *d*, enlarged portion of female plant showing reproductive structures (carpospores).

CUMAGLOIA Setchell and Gardner

Only one species of the genus, *Cumagloia andersonii* (Farlow) Setchell and Gardner, which is described and illustrated here, is recorded from British Columbia.

Cumagloia andersonii **(Farlow) Setchell and Gardner**

Description.—The plant (Fig. 73*a*) is erect, up to 90 cm. tall, with one or more axes arising from a small discoid holdfast. The plants are olive brown to purplish red in colour, gelatinous but of tough consistency. The axes are cylindrical to markedly flattened, usually unbranched, and densely clothed on all sides with short branchlets. Cylindrical axes are 2–8 mm. in diameter; flattened branches up to 5 cm. wide. The branchlets are 20–50 mm. long, less than 2 mm. broad, and sometimes branched. The medulla (Fig. 73*b*) is made up of colourless intertwined longitudinal filaments, surrounded by a cortex of freely branched assimilating filaments.

Habitat.—On rocks in the upper intertidal zone.

Pacific Coast Distribution.—Alaska to Mexico.

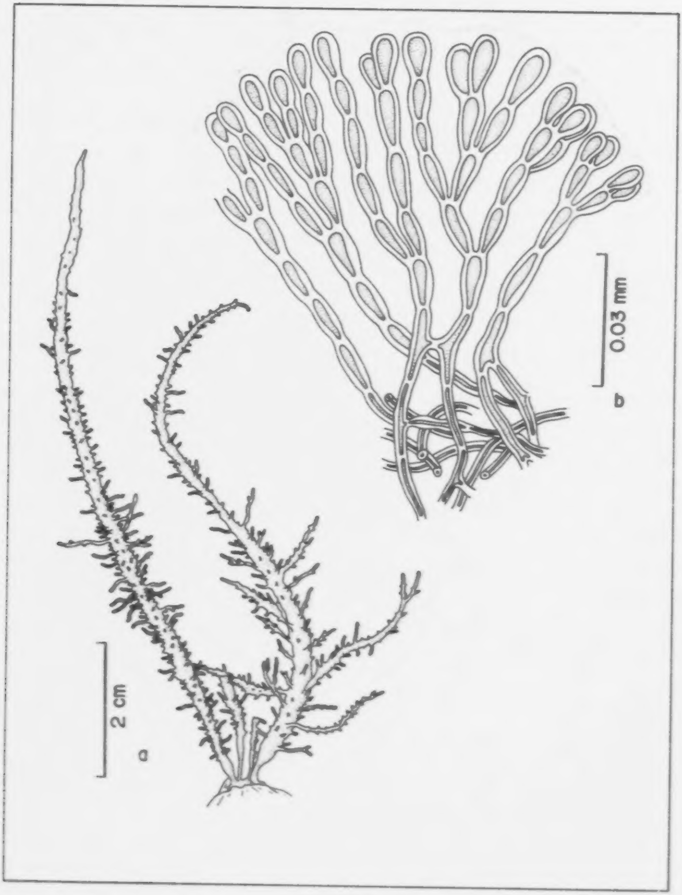


Fig. 73. *Cumagloia andersonii* (Farlow) Setchell and Gardner. *a*, Habit, showing several erect plants clustered together and attached to the substrate; *b*, transverse section of a portion of the plant showing medulla of narrow inertwined filaments, merging into broader branched filaments.

BONNEMAISONIA C. Agardh

Only one species of the genus *Bonnemaisonia, B. nootkana* (Esper) Silva, which is described and illustrated here, is recorded from British Columbia.

Bonnemaisonia nootkana (Esper) Silva

Description.—The plant (Fig. 74*a*) is erect, up to 45 cm. tall, attached to the substrate by a small discoid holdfast; it is pinkish red in colour. The erect axes are oppositely and distichously branched (Fig. 74*b*), with 3–7 orders of progressively smaller similarly branched branches. The branches are cylindrical to compressed, up to 3 mm. in diameter. One of every pair of opposite branches (Fig. 74*c*) is simple, short, and spine-like; the other is long, with one to several orders of branching. The tips of some branches are at times hook-like. The axis has a single axial filament, from which two series of branched filaments arise, terminating at the surface in small cortical cells. Gland cells are numerous among the outer cortical cells.

Habitat.—On rocks in the lower intertidal and upper subtidal zones.

Pacific Coast Distribution. — Northern British Columbia to California.

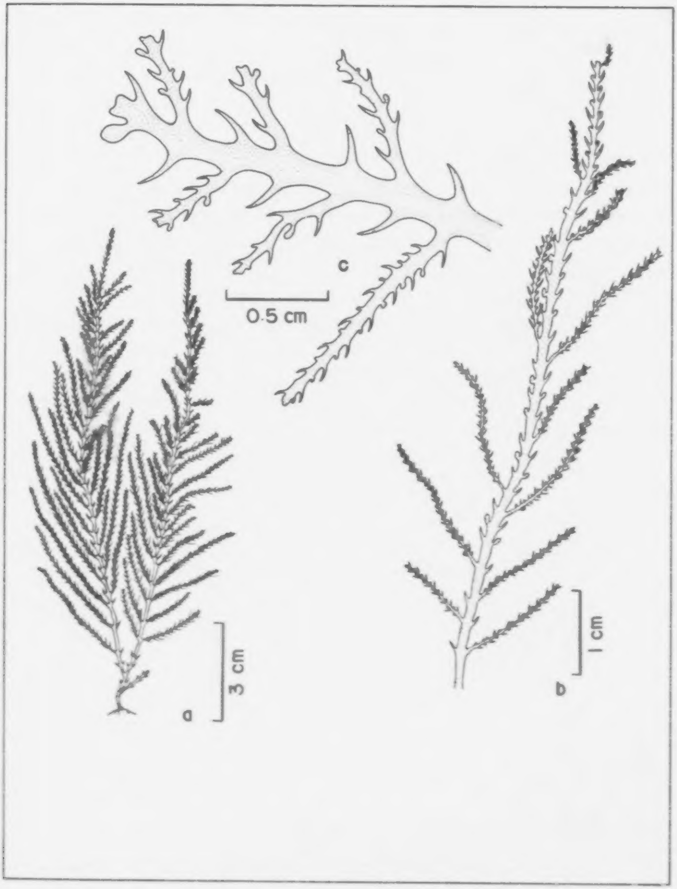


Fig. 74. *Bonnemaisonia nootkana* (Esper) Silva. *a*, Habit showing plant fastened to substrate; *b*, *c*, enlarged views of portions of plant showing details of branching habit.

GELIDIUM Lamouroux

Three species of the genus *Gelidium*—*G. robustum* (Gardner) Hollenberg, *G. crinale* (Turner) Lamouroux, and *G. sinicola* Gardner—are recorded from British Columbia. Two of these, *G. robustum* and *G. sinicola*, are described and illustrated here.

Gelidium robustum **(Gardner) Hollenberg**

Description.—The plant (Fig. 75*a*) occurs in erect tufts, 6–25 cm. high, attached to the substrate by a system of prostrate branches. The plant is stiff and brownish red to purplish red in colour. The lower region of the axis is usually devoid of branches, the upper portion is repeatedly and distichously branched (Fig. 75*b*). The branches are more or less opposite, distinctly compressed, up to 3 mm. broad. The young branchlets have a constricted attachment region, bent in such a way that the branchlet is almost parallel to the axis on which it is borne. Growth is by a single apical cell, from which is derived an axial filament of cells. Cells arise from the axial filament in four quadrately arranged series and produce a compact cortex of cells terminating at the surface in progressively smaller cells.

Habitat.—On rocks in the upper subtidal zone.

Pacific Coast Distribution.—British Columbia to Mexico.

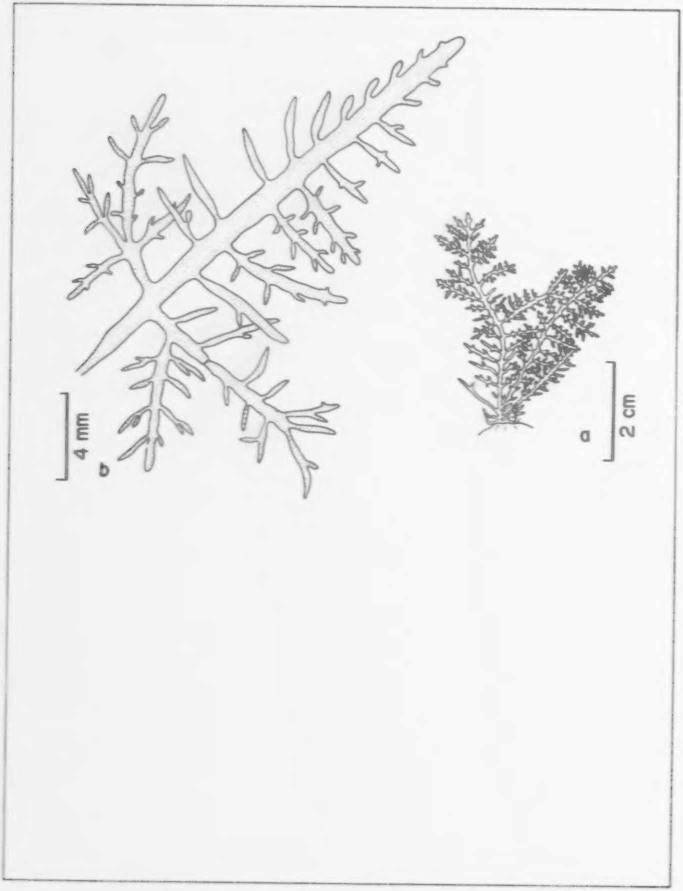


Fig. 75. *Gelidium robustum* (Gardner) Hollenberg. *a*, Habit of plant fastened to substrate; *b*, enlarged view of portion of plant showing branching habit.

Gelidium sinicola Gardner

Description.—The plant (Fig. 76*b*) occurs in dense tufts (Fig. 76*a*), up to 5 cm. high, and is brownish red to purplish red in colour. The erect axes are cylindrical, less than 0.5 mm. in diameter, several times branched, with branches along the erect axis constricted at the base and pointed at the apex. The branches (Fig. 76*c*) are progressively shorter toward the apex of the plant. Growth is by a single apical cell, from which is derived an axial filament of cells. Cells arise from the axial filament in four quadrately arranged series and produce a compact cortex of cells terminating at the surface in progressively smaller cells.

Habitat.—On rocks in the lower intertidal zone.

Pacific Coast Distribution.—British Columbia to California.

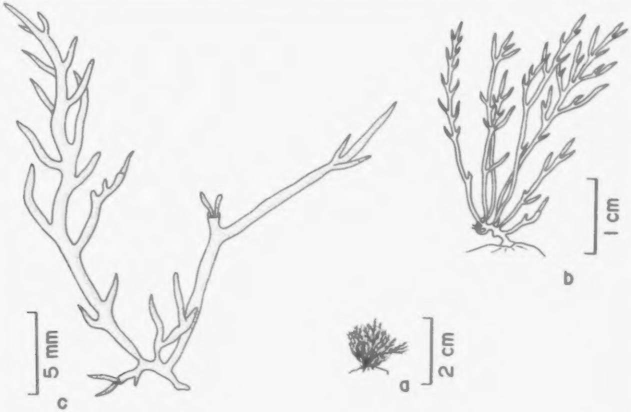


Fig. 76. *Gelidium sinicola* Gardner. *a*, Habit of plant attached to substrate; *b*, enlarged view of portion of plant showing branching habit.

CRYPTOSIPHONIA J. Agardh

Only one species of the genus *Cryptosiphonia, C. woodii* J. Agardh, which is described and illustrated here, is recorded from British Columbia.

Cryptosiphonia woodii J. Agardh

Description.—The plants are erect, 20–35 cm. high, generally in clusters (Fig. 77*a*), and attached to the substrate by a small discoid holdfast. The plants are olive brown to blackish purple in colour. The erect portion is cylindrical and radially branched into progressively smaller branches, without a percurrent axis (Fig. 77*b*). The major branches are approximately the same diameter (1–2 mm.) throughout and bear numerous branchlets (Fig. 77*c*), all approximately the same length (2–4 mm.) and tapering to a point. Growth is by a single apical cell, from which an axial filament arises. Pairs of filaments arise from the axial cells at 90 degrees to each other, alternating in position from one axial cell to the next. These lateral filaments (Fig. 77*d*) are branched and have progressively smaller cells toward the surface, where they terminate in a compact layer of cells. The axial filament eventually is enveloped by many rhizoidal filaments.

Habitat.—On rocks in the intertidal zone.

Pacific Coast Distribution.—Alaska to California.

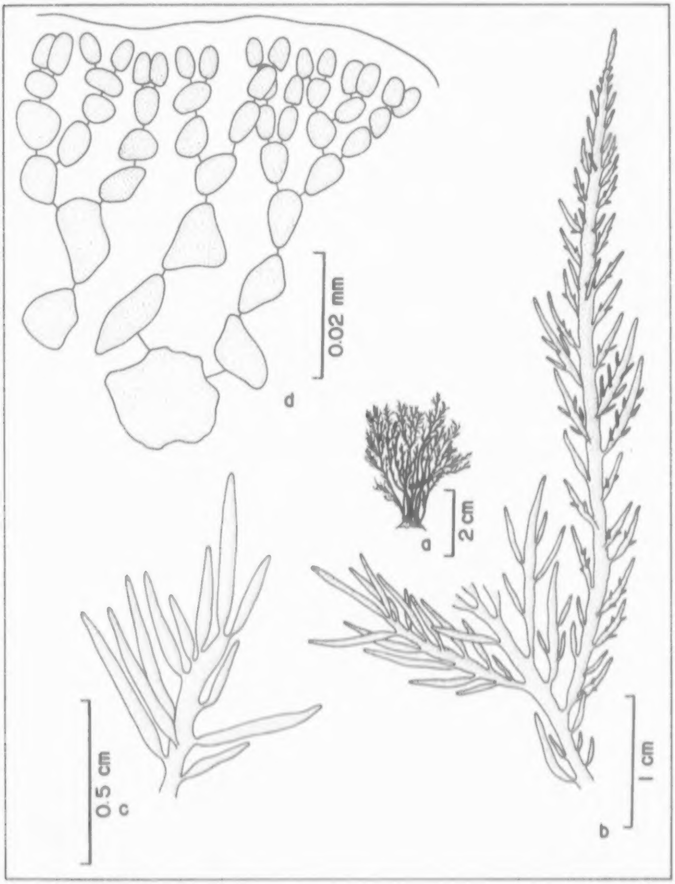


Fig. 77. *Cryptosiphonia woodii* J. Agardh. *a*, Habit of cluster of plants fastened to substrate; *b*, *c*, enlarged views of portions of plant showing branching habit; *d*, transverse section of a portion of the plant showing arrangement of cells.

DILSEA Stackhouse

Only one species of the genus *Dilsea*, *D. californica* (J. Agardh) O. Kuntze, which is described and illustrated here, is recorded from British Columbia.

Dilsea californica (J. Agardh) O. Kuntze

Description.—The plant is an erect flattened blade (Fig. 78*c*) attached in dense clusters (Fig. 78*a*) to the substrate by a small discoid holdfast. The blade is broadly rounded at the apex and tapers to a narrow stipitate region below. The blades are often irregularly and deeply split along incurved lines (Fig. 78*b*). It is brownish red to black in colour. The medulla is made up of densely interwoven filaments, and there is an outer cortex consisting of rows of small cells and an inner cortex of larger cells.

Habitat.—On rocks in the lower intertidal and subtidal zones to a depth of several fathoms.

Pacific Coast Distribution.—Alaska to California.

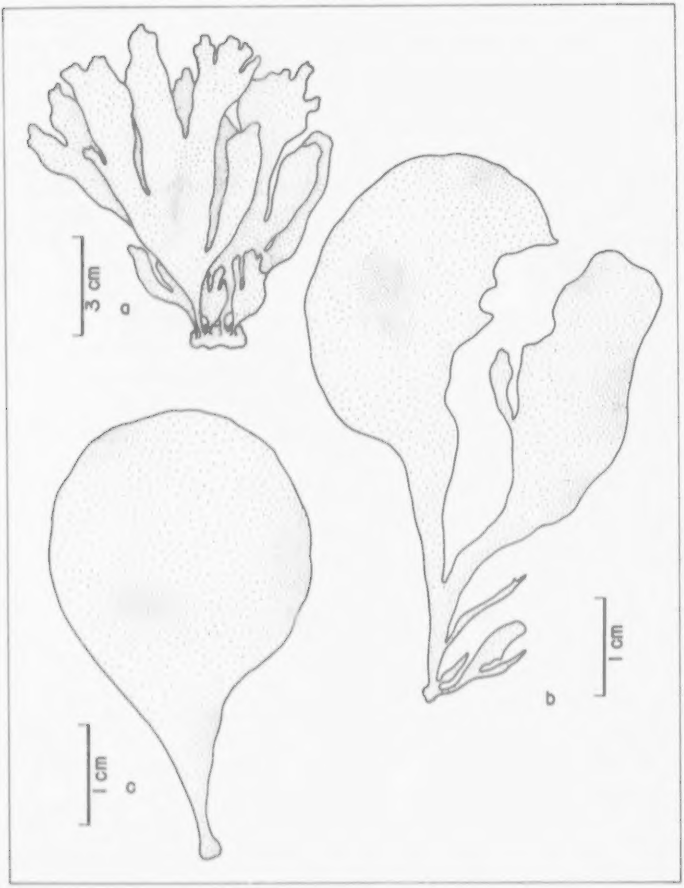


Fig. 78. *Dilsea californica* (J. Agardh) O. Kuntze. *a*, Habit of a cluster of plants attached to substrate; *b*, habit of dissected plant; *c*, habit of entire plant.

CONSTANTINEA Postels and Ruprecht

Two species of the genus *Constantinea*—*C. simplex* Setchell and *C. subulifera* Setchell, both of which are described and illustrated here—are recorded from British Columbia.

Constantinea simplex **Setchell**

Description.—The plant (Fig. 79*b*) is erect, 3–10 cm. high, attached to the substrate by a discoid holdfast at the base of a prominent stout stipe which is simple or rarely with one dichotomy. The distal portion of the plant terminates in one or more horizontal saucer-shaped circular blades (Fig. 79*a*). The circular blade, which is deep red in colour, is up to 12 cm. in diameter and is often radially split into segments at maturity. The stipe is 0.5–1.5 cm. in diameter and 2–8 cm. long. The plant has a medulla of intertwined longitudinal filaments and a cortex of tightly packed cells which are progressively smaller toward the surface.

Habitat.—On rocks in the lower intertidal and upper subtidal zones.

Pacific Coast Distribution.—Alaska to California.

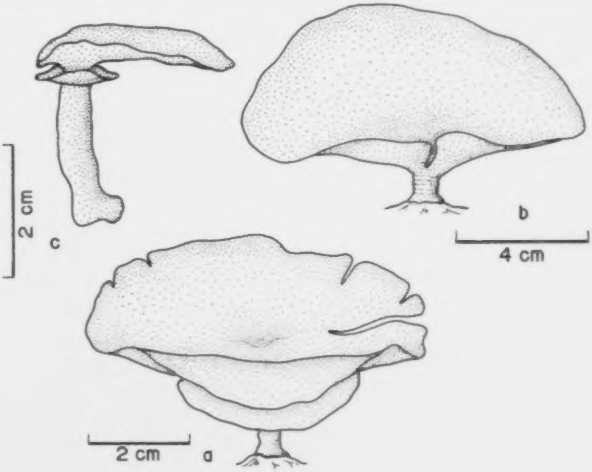


Fig. 79. *Constantinea simplex* Setchell. *a, b,* Habit of plants fastened to substrate; *c,* habit of plant, showing initiation of new blade.

Constantinea subulifera Setchell

Description.—The plant (Fig. 80*b*) is erect, up to 3 cm. high, usually in clusters (Fig. 80*a*) and attached to the substrate by a discoid holdfast at the base of a prominent stipe. The plant is brownish red in colour. The stipe is several times dichotomously branched, and at the apex of each branch there is a saucer-shaped circular blade. The stipe is 3–5 mm. in diameter; the circular blade is up to 30 cm. in diameter and usually deeply split into segments at maturity. The growing point of the stipe penetrates through the blade as a prominent emergence. The plant has a medulla of intertwined filaments and a cortex of tightly packed cells which are progressively smaller toward the surface.

Habitat.—On rocks in the lower intertidal and upper subtidal zones.

Pacific Coast Distribution.—Alaska to Washington.

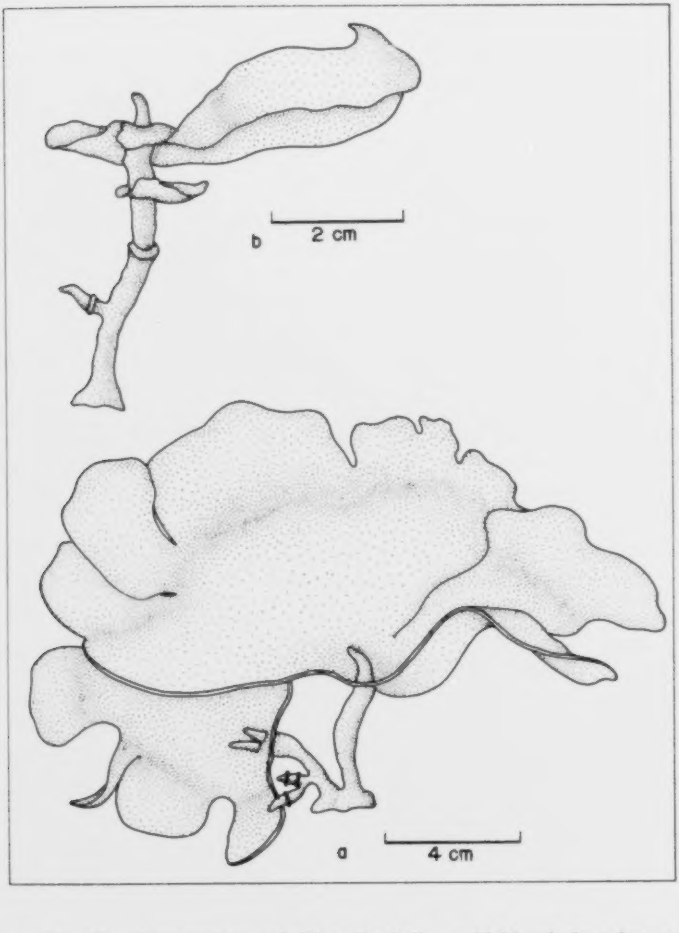


Fig. 80. *Constantinea subulifera* Setchell. *a*, Habit of plant fastened to substrate; *b*, habit of plant showing branching characteristics and initiation of new blade.

BOSSIELLA Silva

Four species of the genus *Bossiella*—*B. californica* (Decaisne) Silva, *B. corymbifera* (Manza) Silva, *B. dichotoma* (Manza) Silva, and *B. plumosa* (Manza) Silva—are recorded from British Columbia . Two of these, *B. californica* and *B. plumosa,* are described and illustrated here.

***Bossiella californica* (Decaisne) Silva**

Description.—The plant (Fig. 81*a*) is erect, 4–12 cm. tall, arising from an encrusting layer attached securely to the substrate. It is reddish pink in colour. The erect portion is a branched system of jointed segments. The branching is irregularly dichotomous. The lower segments are more cylindrical, 2 mm. broad and 1–3 mm. long; the upper segments are compressed, 2–6 mm. broad and 2–5 mm. long. When fertile, 2–8 conceptacles (Fig. 81*b*) occur on the two flattened faces of the segments. The segments are heavily calcified, connected by shorter inconspicuous uncalcified joints. The segments have a medulla of parallel longitudinal filaments in which the cells are of equal length and in transverse rows.

Habitat.—On rocks in the lower intertidal and subtidal zones.

Pacific Coast Distribution.—British Columbia to California.

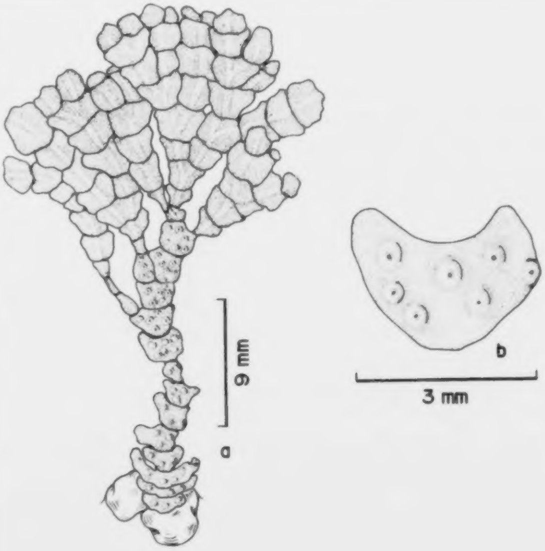


Fig. 81. *Bossiella californica* (Decaisne) Silva. *a*, Habit of fertile plant attached to substrate showing branching characteristics; *b*, enlarged view of a fertile segment showing several conceptacles in surface view.

Bossiella plumosa **(Manza) Silva**

Description.—The plant (Fig. 82*a*) is erect, 3–7 cm. tall, reddish purple in colour, arising from an encrusting basal layer attached securely to the substrate. The erect portion is a branched system of jointed segments. The branching is opposite (Fig. 82*b*), usually with every joint in the upper portion bearing an opposite pair of smaller branches, with the uppermost pairs rebranched and the lowermost pairs simple. The segments in the lower region are only slightly flattened, about 1 mm. in diameter and 1 mm. long. The upper segments are markedly flattened, 1–2 mm. broad and 1 mm. long. When fertile, 2–4 conceptacles occur on the two flattened faces of the segments. The segments are heavily calcified, connected by inconspicuous uncalcified joints. The segments have a medulla of parallel longitudinal filaments in which the cells are of equal length and in transverse rows.

Habitat.—On rocks and shells in the lower intertidal and upper subtidal zones.

Pacific Coast Distribution.—British Columbia to California.

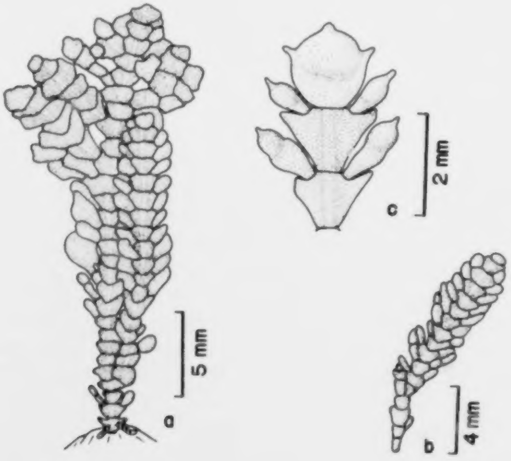


Fig. 82. *Bossiella plumosa* (Manza) Silva. *a*, Habit of plant attached to substrate; *b*, *c*, enlarged views of portions of the plant showing branching characteristics.

CORALLINA L.

Three species of the genus *Corallina*—*C. officinalis* var. *chilensis* (Harvey) Kützing, *C. pilulifera* Postels and Ruprecht, and *C. vancouveriensis* Yendo—are recorded from British Columbia. One of these, *C. vancouveriensis,* is described and illustrated here.

Corallina vancouveriensis Yendo

Description.—The plant (Fig. 83*b*) is erect, 4–10 cm. high, deep purple in colour, arising from an encrusting basal layer attached securely to the substrate. The erect portion is a branched system of jointed segments. The segments below are cylindrical, about 0.75 mm. in diameter; above slightly compressed and about 1 mm. broad. The axes are clothed with narrower short lateral branchlets, all approximately the same length. Branching in the lower region is distichously pinnate with branches usually simple; above distichously pinnate (Fig. 83*a*) or verticillate with branchlets usually pinnately subdivided. When fertile, the conceptacles (Fig. 83*c*) are borne one on a branchlet and at the tip of a terminal segment. The segments are heavily calcified, connected by inconspicuous uncalcified joints. The segments have a medulla of parallel longitudinal filaments in which the cells are of equal length and in transverse rows.

Habitat.—On rocks in the lower intertidal and upper subtidal zones and in tide-pools.

Pacific Coast Distribution.—Alaska to Mexico.

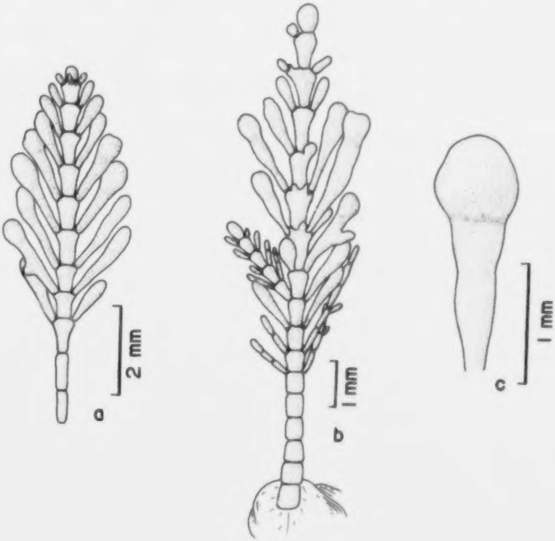


Fig. 83. *Corallina vancouveriensis* Yendo. *a*, Enlarged view of a portion of the plant showing branching characteristics; *b*, habit of plant attached to substrate; *c*, enlarged view of the tip of a branch showing swollen characteristics.

CALLIARTHRON Manza

Three species of the genus *Calliarthron*—*C. pinnulatum* Manza, *C. regenerans* Manza, and *C. schmittii* Manza—are recorded from British Columbia. Two of these, *C. regenerans* and *C. schmittii*, are described and illustrated here.

Calliarthron regenerans Manza

Description.—The plant (Fig. 84*a*) is erect, 7–15 cm. high, reddish purple in colour, with delicate branches, arising from an encrusting basal layer securely fastened to the substrate. Branching irregularly pinnate and opposite. Segments in lower region cylindrical to compressed (1–2 mm. in diameter and 1–3 mm. long); segments in distal region variably cylindrical to compressed (3–5 mm. broad and 2–3 mm. long) with lobes of segments rounded. When fertile, conceptacles (Fig. 84*b*) occur on flattened faces of the segments. The segments are heavily calcified, connected by inconspicuous uncalcified joints. The segments have a medulla of long intertwined filaments in which the cells are not in transverse rows.

Habitat.—On rocks in tide-pools and in the subtidal zone.

Pacific Coast Distribution.—British Columbia to Mexico.

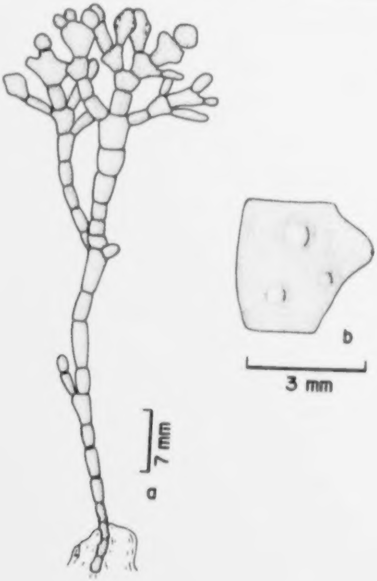


Fig. 84. *Calliarthron regenerans* Manza. *a*, Habit of plant attached to substrate; *b*, enlarged view of a fertile segment showing swollen conceptacles.

Calliarthron schmittii Manza

Description.—The plant (Fig. 85*a*) is erect or almost creeping in habit, reddish purple in colour, with branches up to 3 cm. long arising from an encrusting layer securely fastened to the substrate. The branching is irregularly dichotomous. The basal segments may be cylindrical, 1 mm. in diameter and 1–4 mm. long; above the segments are compressed, 5–15 mm. wide and 5–10 mm. long, with pronounced differentiation between a midrib region and thinner flattened wings. When fertile, the conceptacles (Fig. 85*b*) occur on the flattened faces of the segments. The segments are heavily calcified, connected by inconspicuous uncalcified joints. The segments have a medulla of long intertwined filaments in which the cells are not in transverse rows.

Habitat.—On rocks in tide-pools and in the lower intertidal and subtidal zones.

Pacific Coast Distribution.—British Columbia to California.

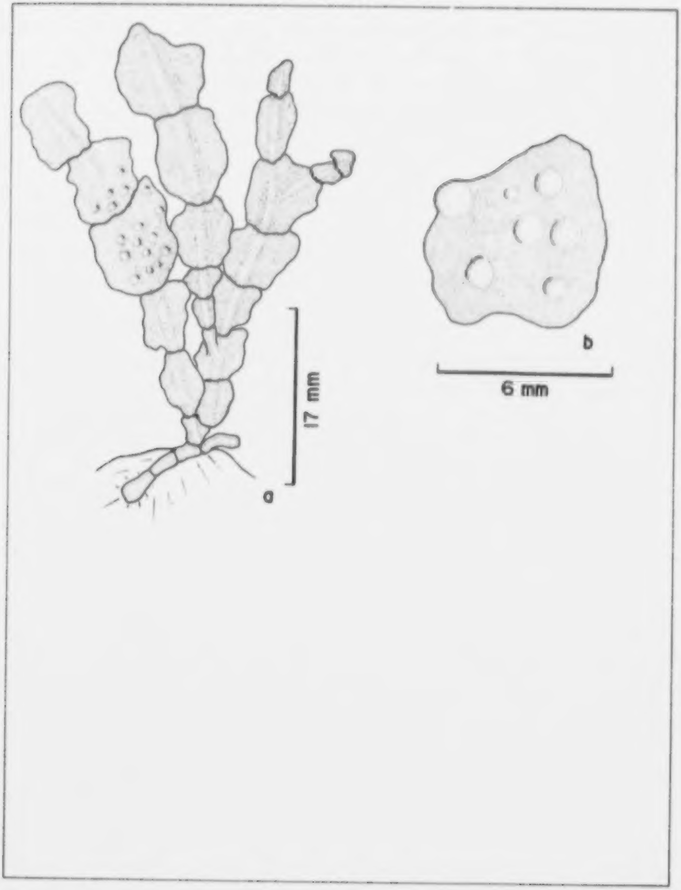


Fig. 85. *Calliarthron schmittii* Manza. *a*, Habit of plant attached to substrate; *b*, enlarged view of a fertile segment showing several swollen conceptacles.

GLOIOSIPHONIA Carmichael

Three species of the genus *Gloiosiphonia*—*G. californica* (Farlow) J. Agardh, *G. capillaris* (Hudson) Carmichael, and *G. verticillaris* Farlow—are recorded from British Columbia. One of these, *G. verticillaris,* is described and illustrated here.

Gloiosiphonia verticillaris Farlow

Description.—The plant (Fig. 86*a*) is erect, usually in clusters 10–40 cm. tall, attached to the substrate by a small discoid holdfast, and is a bright rosy red. At intervals the conspicuous main axis (0.5–1.5 mm. in diameter) has transverse whorls (Fig. 86*b*) of branchlets, 3–6 to each whorl, all approximately the same length (up to 2 cm. long). The plant has a gelatinous but firm texture. The plant has a single axial filament, from each cell of which four quadrately arranged systems of branches arise. The outer ends of these branched filaments are laterally adjoined to form a compact cellular cortex (Fig. 86*d*). In older portions the axial filament is surrounded by rhizoidal filaments.

Habitat.—On stones in the upper subtidal zone.

Pacific Coast Distribution.—Alaska to California.

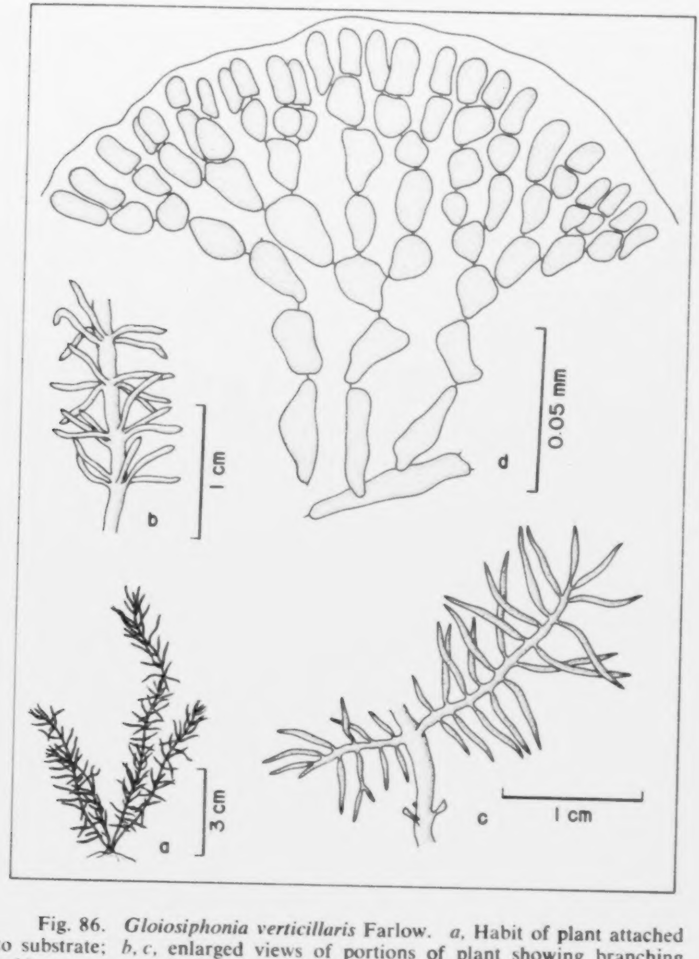


Fig. 86. *Gloiosiphonia verticillaris* Farlow. *a*, Habit of plant attached to substrate; *b*, *c*, enlarged views of portions of plant showing branching habit; *d*, transverse section of a portion of the plant showing arrangement of cells.

ENDOCLADIA J. Agardh

Only one species of the genus *Endocladia, E. muricata* (Harvey) J. Agardh, which is described and illustrated here, is recorded from British Columbia.

Endocladia muricata (Harvey) J. Agardh

Description.—The plant (Fig. 87*a*) is erect, 4–8 cm. tall, profusely and irregularly branched, usually growing in tufts, and dark red to blackish or greenish brown in colour. The branches are cylindrical, about 0.5 mm. in diameter and covered with minute conical spines (Fig. 87*b*) about 0.5 mm. in length. The plant has a single axial filament in which each cell bears two lateral filaments disposed at a 90-degree angle, alternating in position from one axial cell to the next. The lateral filaments are profusely branched and terminate in a compact cortex toward the surface.

Habitat.—On rocks in the upper intertidal zone.

Pacific Coast Distribution.—Alaska to Mexico.

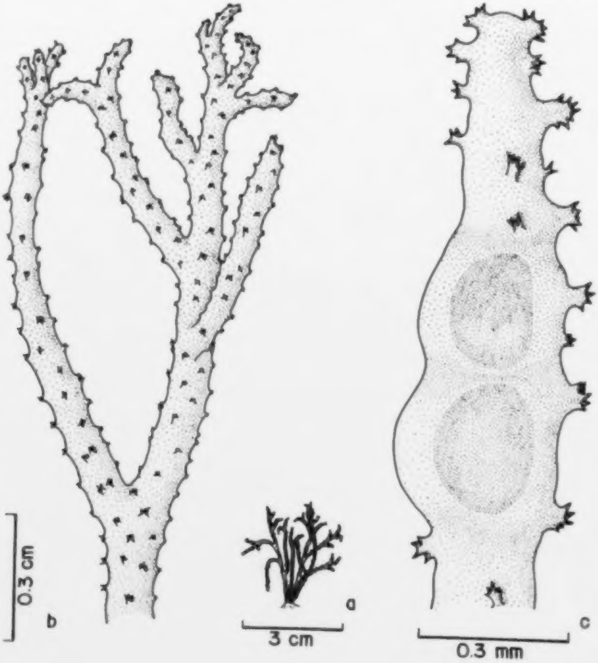


Fig. 87. *Endocladia muricata* (Harvey) J. Agardh. *a*, Habit of plant attached to subtrate; *b*, *c*, enlarged views of portions of the plant showing branching characteristic and ultimate spiny branchlets.

GLOIOPELTIS J. Agardh

Only one species of the genus *Gloiopeltis*, *G. furcata* (Postels and Ruprecht) J. Agardh, which is described and illustrated here, is recorded from British Columbia.

Gloiopeltis furcata (Postels and Ruprecht) J. Agardh

Description.—The plant is erect, simple (Fig. 88*b*) or dichotomously divided (Fig. 88*c*), up to 6 cm. tall, growing in dense tufts (Fig. 88*a*). The plant is terete, with branches being narrower near the basal attachment region, becoming broader (up to 4 mm. in diameter) above, and tapering at the apices. The plant is gelatinous but tough in texture and reddish brown in colour. The plant has a central axial filament, at maturity loosely surrounded by rhizoidal filaments, and a firmly compacted surface region of small cells (Fig. 88*d*).

Habitat.—On rocks in the upper intertidal zone.

Pacific Coast Distribution.—Alaska to California.

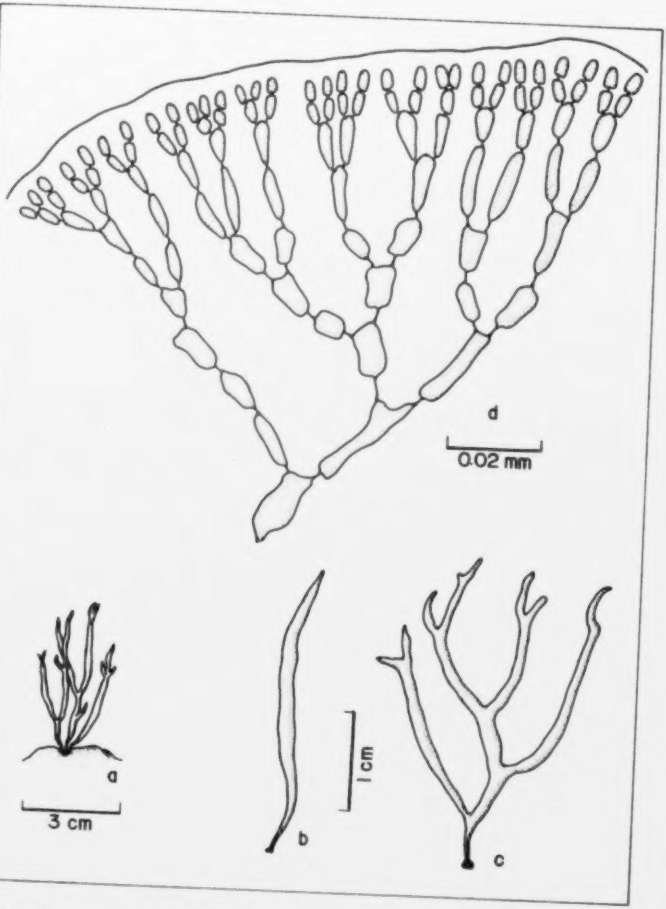


Fig. 88. *Gloiopeltis furcata* (Postels and Ruprecht) J. Agardh. *a*, Habit of cluster of plants attached to the substrate; *b*, *c*, single plants, showing variation in growth form and branching habit; *d*, cross section of portion of the plant showing arrangement of cells.

GRATELOUPIA C. Agardh

Two species of the genus *Grateloupia* — *G. californica* Kylin and *G. pinnata* (Postels and Ruprecht) Setchell — are recorded from British Columbia. One of these, *G. californica,* is described and illustrated here.

Grateloupia californica **Kylin**

Description.—The plant (Fig. 89*a*) is erect, up to 2 m. tall, often in tufts, brownish red to olive purple in colour, and of soft gelatinous or slimy texture. The plant is attached by a small discoid holdfast with a short cylindrical stipe above, merging gradually into a broad linear to lanceolate blade up to 10 cm. wide. The margins of the blade may or may not have proliferous bladelets. The medulla is made up of stellate cells with long processes; the cortex is of compacted short filaments, 6–7 cells in length, standing perpendicular to the surface (Fig. 89*b*).

Habitat.—On rocks and epiphytic on other algæ in the lower intertidal and upper subtidal zones and in tide-pools.

Pacific Coast Distribution.—British Columbia to Mexico.

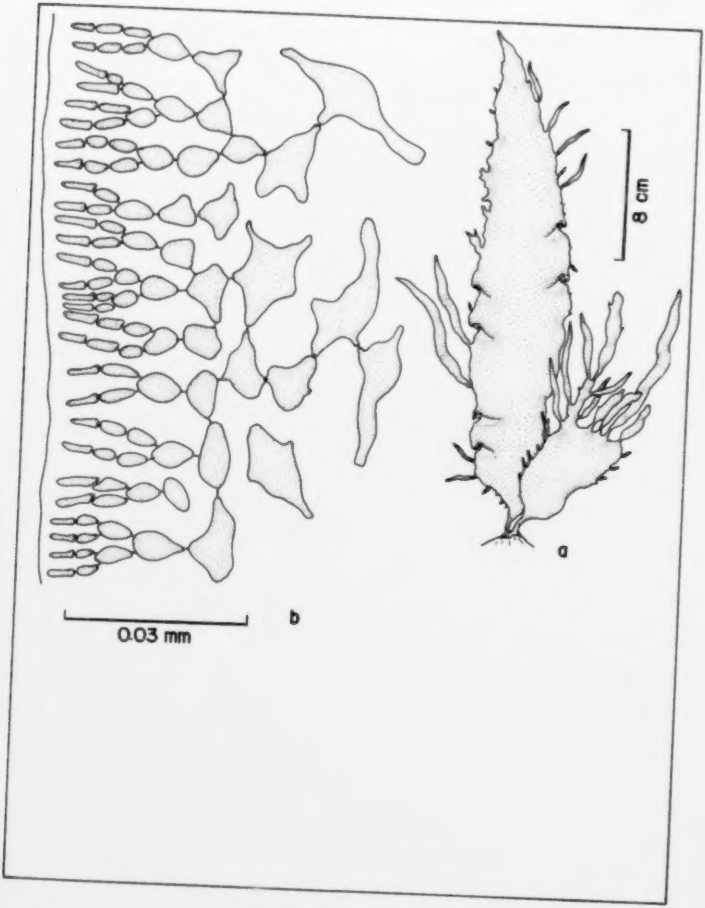


Fig. 89. *Grateloupia californica* Kylin. *a*, Habit of cluster of plants attached to substrate; *b*, transverse section of a portion of the plant showing arrangement of cells.

PRIONITIS J. Agardh

Two species of the genus *Prionitis*—*P. lanceolata* Harvey and *P. lyallii* Harvey, both of which are described and illustrated here—are recorded from British Columbia.

Prionitis lanceolata **Harvey**

Description.—The plant is erect, up to 35 cm. tall, dull brown to reddish purple in colour, growing in clusters (Fig. 90*a*), and attached to the substrate by a small discoid holdfast. The erect portion is narrowly stipitate below, tapering above to a flattened lanceolate portion (3–8 mm. broad), which may be further and irregularly branched (Fig. 90*b*). The apices of the branches taper gradually to a point. Numerous proliferous flattened short pinnately arranged branchlets (3–8 mm. broad) occur along the margins of the main axes (Fig. 90*c*). The medulla is made up of densely compacted, erect branched filaments with progressively smaller cells toward the surface.

Habitat.—On rocks in the lower intertidal and upper subtidal zones.

Pacific Coast Distribution.—Alaska to Mexico.

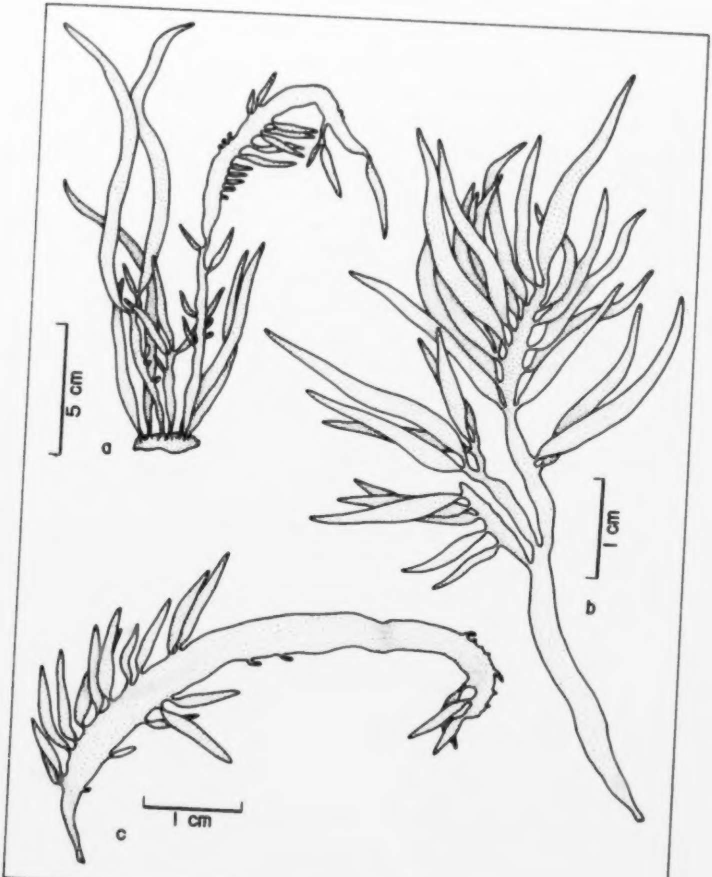


Fig. 90. *Prionitis lanceolata* Harvey. *a*, Habit of a cluster of plants attached to substrate; *b*, *c*, enlarged views of two plants showing branching habit.

Prionitis lyallii Harvey

Description.—The plant (Fig. 91*a*) is erect, up to 30 cm. tall, reddish brown in colour, growing in clusters (Fig. 91*b*), and attached to the substrate by a small discoid holdfast. The erect portion is narrowly stipitate below, tapering above to a flattened lanceolate portion (up to 5 mm. broad) which may be further and irregularly branched. The apices of the branches taper gradually to a point. Numerous proliferous flattened short pinnately arranged branchlets (3–8 mm. broad) occur along the margins of the main axes. The medulla is made up of densely compacted, erect branched filaments, with progressively smaller cells toward the surface.

Habitat.—On rocks in tide-pools in the intertidal zone.

Pacific Coast Distribution.—Alaska to Mexico.

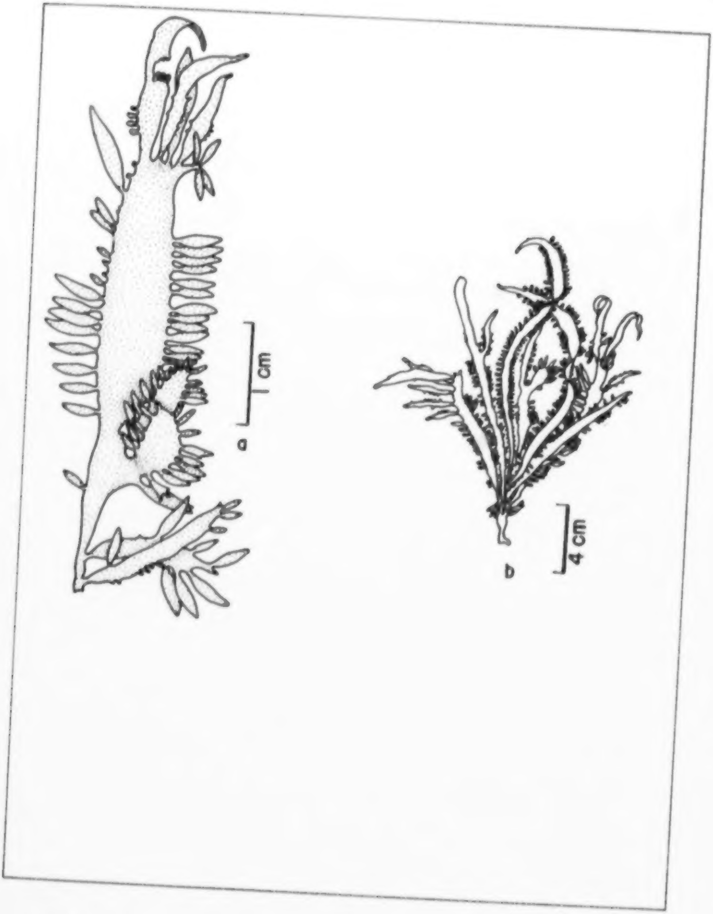


Fig. 91. *Prionitis lyallii* Harvey. *a*, Habit of a single plant; *b*, enlarged view of a portion of a plant showing branching habit.

CALLOPHYLLIS Kützing

Eight species of the genus *Callophyllis*—*C. crenulata* Setchell, *C. edentata* Kylin, *C. firma* (Kylin) Norris, *C. flabellulata* Harvey, *C. heanophylla* Setchell, *C. marginifructa* Setchell and Swezy, *C. megalocarpa* Setchell and Swezy, and *C. thompsonii* Setchell—are recorded from British Columbia. Two of these, *C. edentata* and *C. flabellulata*, are described and illustrated here.

Callophyllis edentata **Kylin**

Description.—The plant (Fig. 92*a*) is erect, up to 20 cm. high, dark red in colour, 4–6 times irregularly dichotomously branched, with branches flat lying in a fan-like arrangement, and attached to the substrate by a small discoid holdfast. Segments narrow below, becoming broader above (8–15 mm. wide) and then with younger branches becoming progressively narrower. Ultimate branches lobed or rounded at apices. Margins of blades sometimes finely crisped. The plant possesses a medulla of very large compact cells intermingled with smaller cells, and with progressively smaller cells toward the surface (Fig. 92*b*).

Habitat.—On rocks and shells in the subtidal zone and to a depth of 5–10 fathoms.

Pacific Coast Distribution.—British Columbia to Oregon.

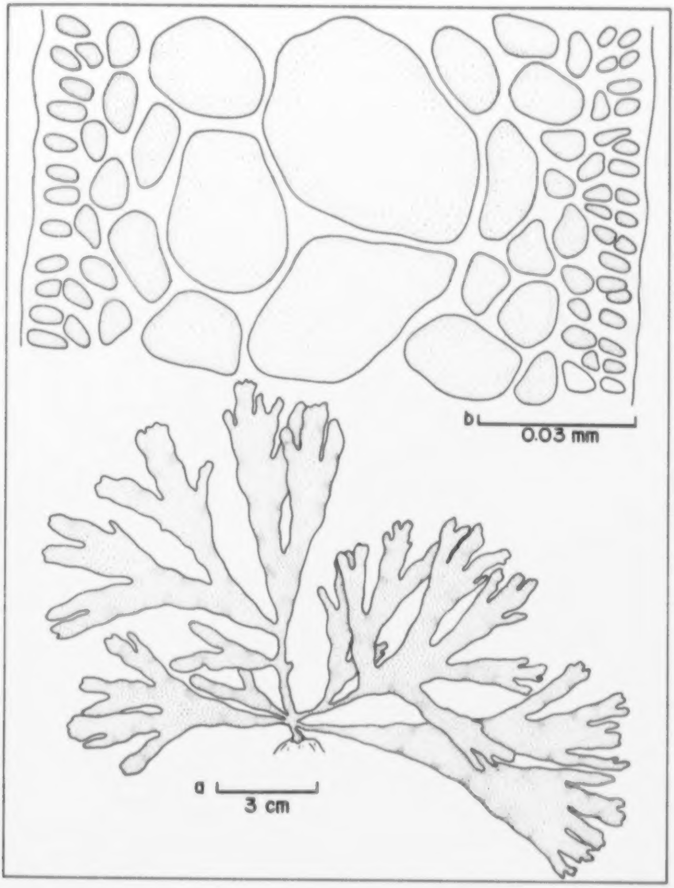


Fig. 92. *Callophyllis edentata* Kylin. *a,* Habit of a single plant attached to the substrate; *b,* transverse section of a portion of the plant showing arrangement of cells.

Callophyllis flabellulata Harvey

Description.—The plant (Fig. 93*a*) is erect, up to 18 cm. high, orange red to dark red in colour, 5–6 times irregularly dichotomously branched with branches flat lying in a fan-like arrangement, and attached to the substrate by a small discoid holdfast. Segments narrow below, becoming broader above (3–5 cm. wide) and then with younger branches becoming progressively narrower. Ultimate branches with pointed apices. The plant possesses a medulla of very large compact cells intermingled with smaller cells, and with progressively smaller cells toward the surface (Fig. 93*b*).

Habitat.—On rocks in the subtidal zone to a depth of 5–10 fathoms.

Pacific Coast Distribution.—Alaska to California.

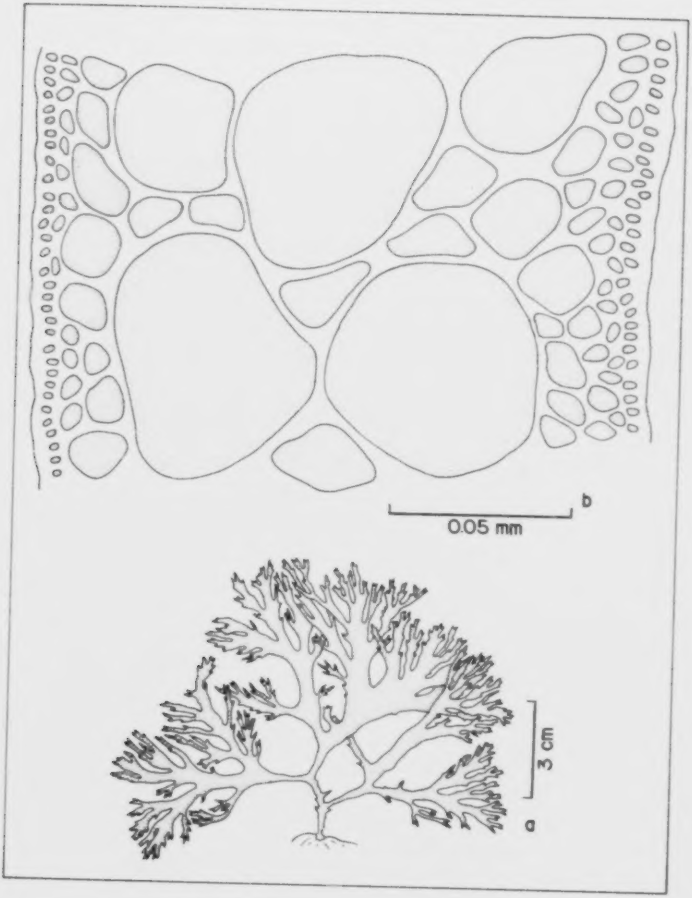


Fig. 93. *Callophyllis flabellulata* Harvey. *a,* Habit of plant attached to substrate; *b,* transverse section of a portion of a plant showing arrangement of cells.

ERYTHROPHYLLUM J. Agardh

Only one species of the genus *Erythrophyllum, E. delesserioides* J. Agardh, which is described and illustrated here, is recorded from British Columbia.

Erythrophyllum delesserioides **J. Agardh**

Description.—The plant (Fig. 94*b*) is erect, up to 40 cm. high, purplish red in colour, generally in clusters (Fig. 94*a*), and attached to the substrate by a discoid holdfast. The plant is simple, or branched, with a stipitate base which merges into a flattened blade 6–14 cm. broad with a conspicuous percurrent midrib. In old blades the flattened margins become deeply lacerated. The medulla is made up of colourless longitudinal filaments, merging into a cortex of rounded cells that are progressively smaller toward the surface of the plant.

Habitat.—On rocks in the lower intertidal and upper subtidal zones.

Pacific Coast Distribution.—Alaska to California.

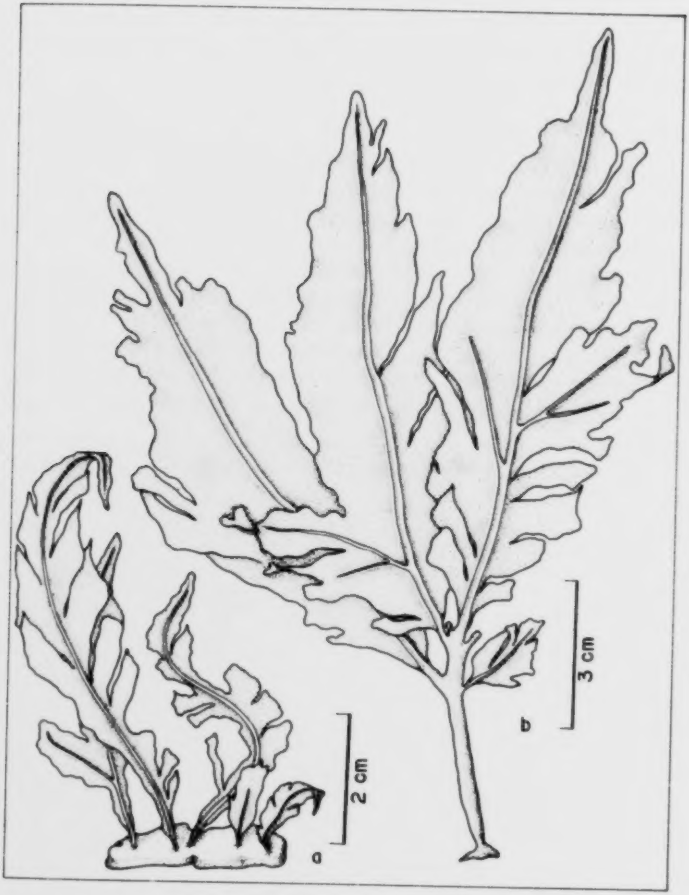


Fig. 94. *Erythrophyllum delesserioides* J. Agardh. *a*, Habit showing several plants attached to the substrate; *b*, enlarged view of a single plant showing branching characteristics.

SCHIZYMENIA J. Agardh

Only one species of the genus *Schizymenia, S. pacifica* Kylin, which is described and illustrated here, is recorded from British Columbia.

Schizymenia pacifica **Kylin**

Description.—The plant (Fig. 95*a*) is erect, with one or more ovate, reniform or lanceolate blades, up to 60 cm. high, undivided but at times deeply laciniate, soft in texture and slimy, rich brownish red in colour. The plant is fastened to the substrate by a small discoid holdfast. The blade is smooth or sometimes slightly wrinkled. The medulla (Fig. 95*b*) is made up of interwoven colourless filaments, and the cortex has filaments of progressively smaller cells to the surface. Numerous large cylindrical to ellipsoidal gland cells (Fig. 95*b*) occur in the cortex near the surface.

Habitat.—On rocks in the lower intertidal and upper subtidal zones.

Pacific Coast Distribution.—Alaska to Mexico.

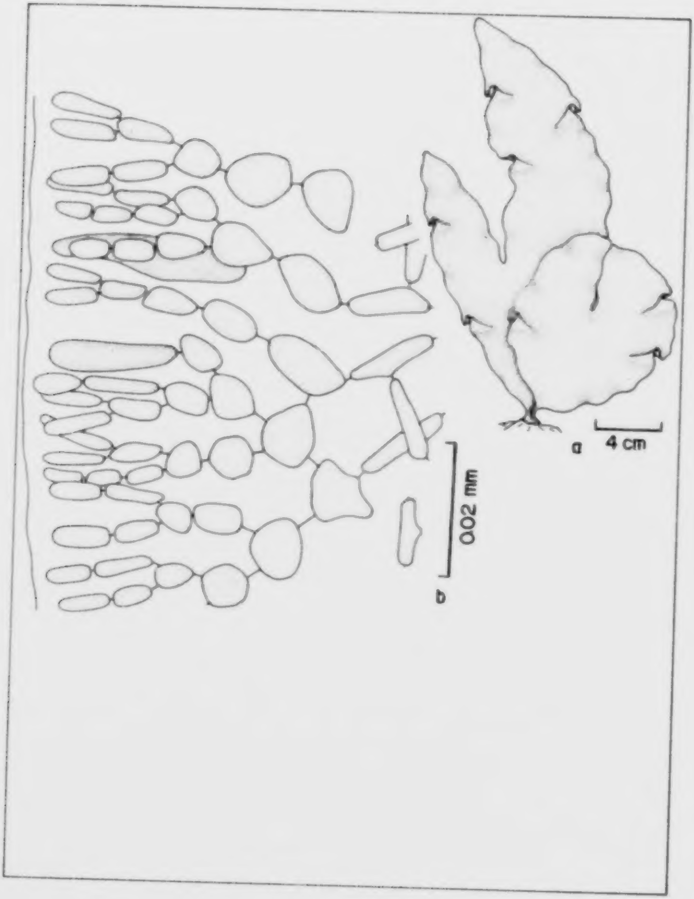


Fig. 95. *Schizymenia pacifica* Kylin. *a*, Habit of a cluster of plants attached to the substrate; *b*, transverse section of a portion of the plant showing arrangement of cells.

AGARDHIELLA Schmitz

Only one species of the genus *Agardhiella, A. tenera* (J. Agardh) Schmitz, which is described and illustrated here, is recorded from British Columbia.

Agardhiella tenera (J. Agardh) Schmitz

Descripiton.—The plant (Fig. 96*a*) is erect, up to 40 cm. high, bright pink to deep red in colour, usually in clusters. The plant has an obscure cylindrical branched central axis, 2–3 mm. in diameter, with the branches radially arranged or tending to lie in one plane. The branches are narrow at the base and taper gradually to a pointed apex. The medulla (Fig. 96*c*) is made up of parallel longitudinal filaments with progressively smaller cells toward the surface and with a compact layer of small cells at the surface.

Habitat.—On rocks in the subtidal zone to a depth of 10 fathoms.

Pacific Coast Distribution.—Alaska to Mexico.

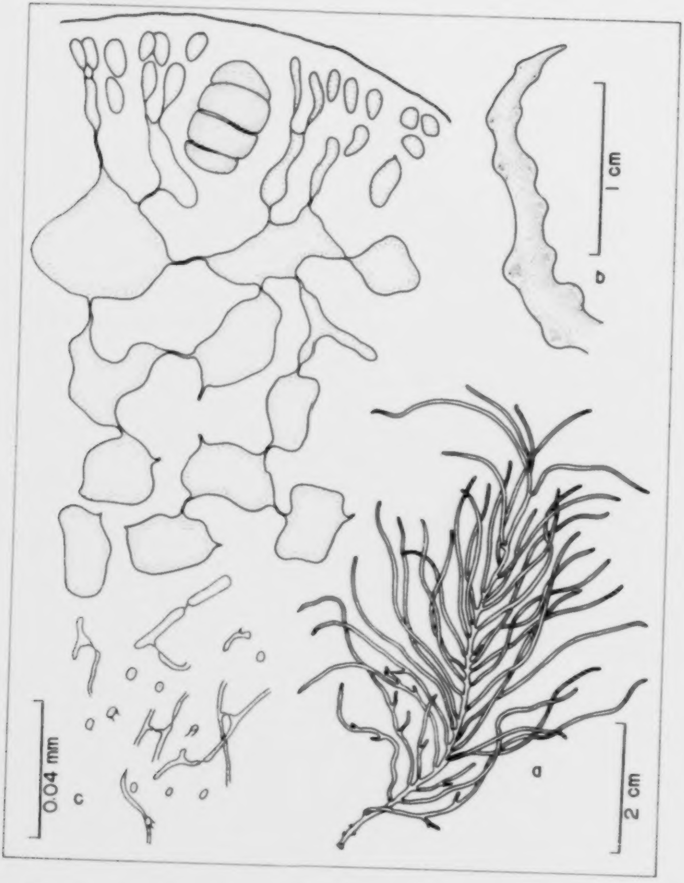


Fig. 96. *Agardhiella tenera* (J. Agardh) Schmitz. *a*, Habit of a plant showing branching characteristics; *b*, enlarged view of a portion of the plant showing swollen appearance of cystocarpic region; *c*, transverse section of a portion of the plant showing filamentous medulla, cellular cortex, and a tetrasporangium with zonately arranged tetraspores.

OPUNTIELLA Kylin

Only one species of the genus *Opuntiella, O. californica* (Farlow) Kylin, which is described and illustrated here, is recorded from British Columbia.

Opuntiella californica **(Farlow) Kylin**

Description.—The plant (Fig. 97*a*) is erect, up to 20 cm. tall and 30 cm. broad, with a flattened primary blade, 12–15 cm. in diameter, attached to the substrate by a discoid holdfast. The margin of the primary blade has stipitate flat proliferous circular blades of the same size or larger than the primary blade arising from it, and these in turn, in large plants, also bear proliferous blades. The plant is thick, of firm texture, and a dark red in colour. The medulla is made up of densely compacted intertwined filaments, and the cortex is made up of compacted vertical filaments of progressively smaller cells toward the surface. Numerous large colourless gland cells occur in the outer cortex near the surface (Fig. 97*b*).

Habitat.—On rocks in the lower intertidal and subtidal zones to a depth of about 10 fathoms.

Pacific Coast Distribution.—Alaska to California.

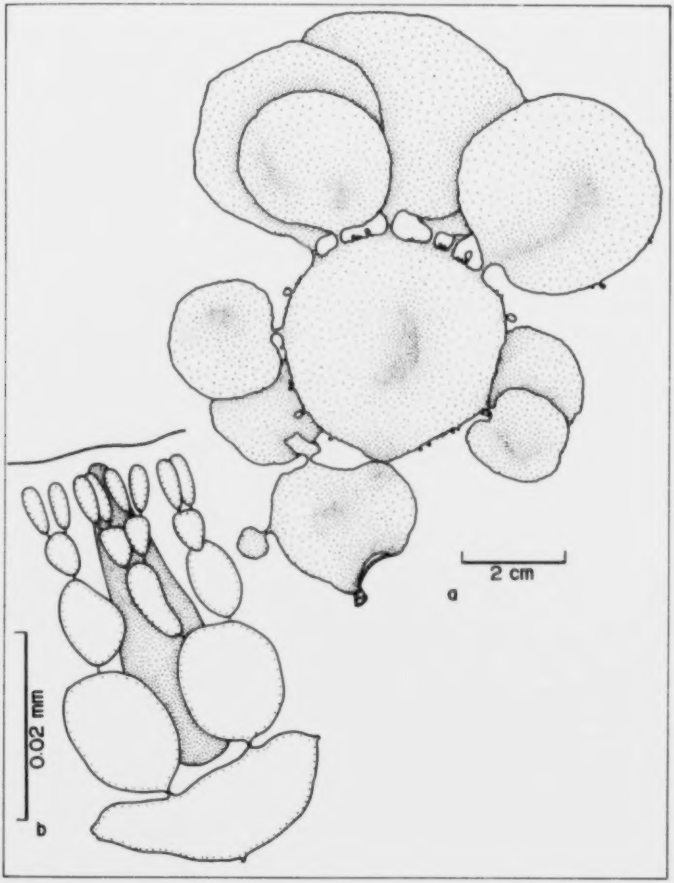


Fig. 97. *Opuntiella californica* (Farlow) Kylin. *a*, Habit of a single plant, showing branching characteristics; *b*, transverse section of a portion of the plant showing large gland cell near the surface.

PLOCAMIUM Lamouroux

Four species of the genus *Plocamium—P. oregonum* Doty, *P. pacificum* Kylin, *P. tenue* Kylin, and *P. violaceum* Farlow — are recorded from British Columbia. One of these, *P. pacificum*, is described and illustrated here.

Plocamium pacificum **Kylin**

Description.—The plant (Fig. 98*a*) is a deep-red colour, erect, up to 30 cm. high, profusely branched, with 4–7 orders of narrow branches, below slightly compressed, above flattened, 1–2 mm. broad. Branching pectinate (Fig. 98*b, c*), with distal branches curved with 4–5 branchlets (Fig. 98*c*) on each pectination. The plant is attached to the substrate by a small discoid holdfast or by prostrate branches.

Habitat.—On rocks in the lower intertidal and subtidal zones to a depth of 8 fathoms.

Pacific Coast Distribution.—British Columbia to Mexico.

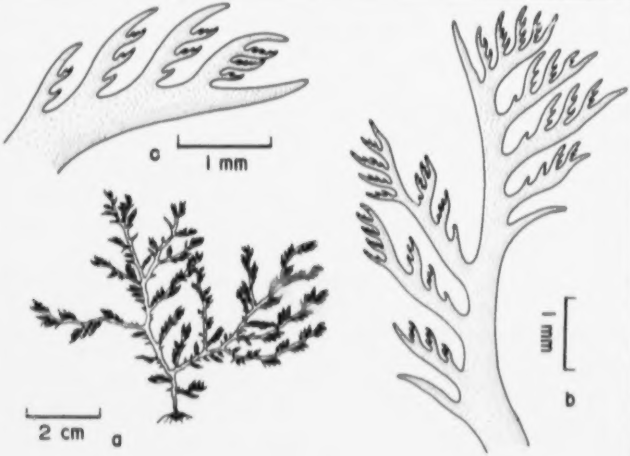


Fig. 98. *Plocamium pacificum* Kylin. *a*, Habit of plant attached to substrate; *b*, *c*, enlarged views of portions of the plant showing pectinate branching characteristics.

GRACILARIOPSIS Dawson

Only one species of the genus *Gracilariopsis*, *G. sjæstedtii* (Kylin) Dawson, which is described and illustrated here, is recorded from British Columbia.

Gracilariopsis sjæstedtii (Kylin) Dawson

Description.—The plant (Fig. 99*a*) is erect, up to 2 m. tall, usually in clusters, usually attached to the substrate by a small discoid holdfast. Branches irregularly branched, sometimes with numerous short proliferous branches (Fig. 99*b*). The branches are cylindrical and cartilaginous. The plant is usually reddish brown or reddish purple in colour. The branch apices terminate in a single apical cell. The medulla is made up of compacted large colourless cells which merge in the cortex (Fig. 99*d*) into progressively smaller compacted cells toward the surface. Connecting filaments do not occur between the pericarp and the gonimoblast (Fig. 99*e*).

Habitat.—On rocks and shells in the lower intertidal and upper subtidal zones.

Pacific Coast Distribution.—British Columbia to Mexico.

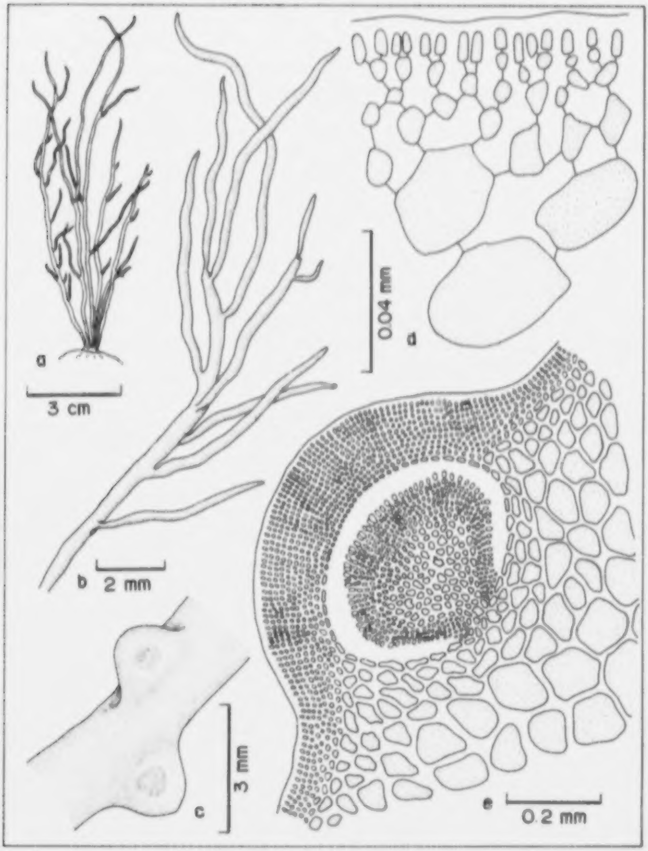


Fig. 99. *Gracilariopsis sjæstedtii* (Kylin) Dawson. *a*, Habit of plant attached to substrate; *b*, enlarged view of portion of the plant showing branching habit; *c*, enlarged surface view of fertile portion of plant showing two cystocarps; *d*, transverse section through a fertile portion of plant showing anatomical details of cystocarp region; *e*, transverse section through a portion of the vegetative region of a plant showing arrangement of cells.

AHNFELTIA Fries

Two species of the genus *Ahnfeltia*—*A. concinna* J. Agardh and *A. plicata* (Hudson) Fries, both of which are described and illustrated here—are recorded from British Columbia.

Ahnfeltia concinna J. Agardh

Description.—The plant is erect, up to 30 cm. tall, deep red to purplish black in colour, growing in dense tufts (Fig. 100*b*), attached securely to the substrate by a discoid holdfast. The plant is wiry and stiff. The erect axes (Fig. 100*a*) are cylindrical, 0.5–1.0 mm. in diameter, repeatedly and dichotomously branched, usually at intervals of 15–30 mm., sometimes with numerous short proliferous branches near the base. The medulla is made up of narrow parallel longitudinal filaments and a cortex of densely compacted filaments of small cells.

Habitat.—On rocks in the lower intertidal and upper subtidal zones.

Pacific Coast Distribution.—Alaska to Mexico.

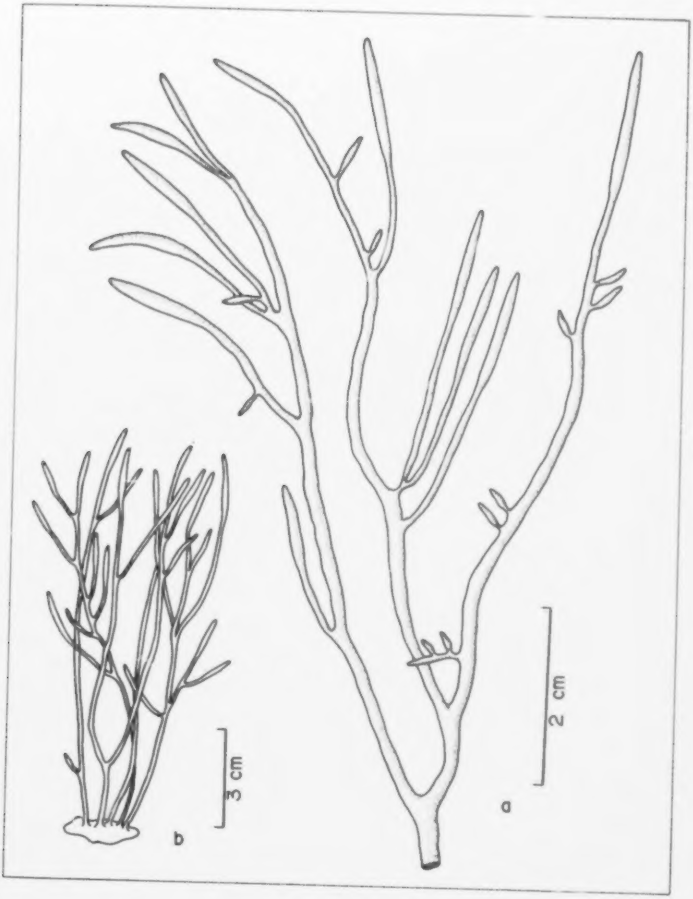


Fig. 100. *Ahnfeltia concinna* J. Agardh. *a*, Habit of a cluster of plants attached to the substrate; *b*, enlarged portion of a plant showing branching habit.

***Ahnfeltia plicata* (Hudson) Fries**

Description.—The plant (Fig. 101*a*) is erect, up to 15 cm. high, deep reddish purple to purplish black in colour, in dense tufts, attached securely to the substrate by a discoid holdfast. The plant is rigid and wiry, with branches densely tangled. The erect axes are cylindrical, 0.25–0.5 mm. in diameter, repeatedly and dichotomously branched (Fig. 101*b*), usually at intervals of 5–10 mm., sometimes with numerous short proliferous branches. The medulla is made up of narrow parallel longitudinal filaments and the cortex of densely compacted filaments of small cells (Fig. 101*c*).

Habitat.—On rocks in the lower intertidal and upper subtidal zones.

Pacific Coast Distribution.—Bering Sea to Mexico.

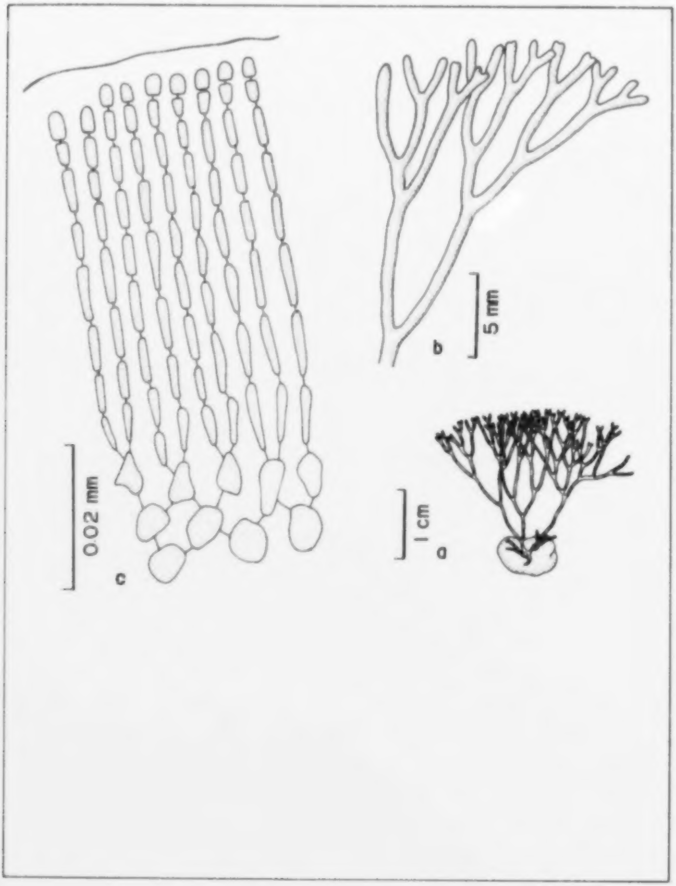


Fig. 101. *Ahnfeltia plicata* (Hudson) Fries. *a*, Habit of a plant attached to the substrate; *b*, transverse section of a portion of the plant showing arrangement of cells.

GYMNOGONGRUS Martius

Three species of the genus *Gymnogongrus*—*G. linearis* (Turner) J. Agardh, *G. norvegicus* (Gunner) J. Agardh, and *G. platyphyllus* Gardner — are recorded from British Columbia. Two of these, *G. linearis* and *G. platyphyllus,* are described and illustrated here.

Gymnogongrus linearis (Turner) J. Agardh

Description.—The plant is erect, up to 18 cm. high, in clusters (Fig. 102*a*), attached to the substrate by a small discoid holdfast. The erect branches are firm to horny in texture, repeatedly dichotomous, with all branches lying in the same plane. The plant is cylindrical below the first dichotomy, above markedly compressed (5–8 mm. wide) and over 1 mm. thick. The plant is light brown to brownish purple in colour. The medulla is made up of large angular cells, the cortex of laterally compacted filaments of small cells.

Habitat.—On rocks in the lower intertidal zone.

Pacific Coast Distribution.—British Columbia to California.

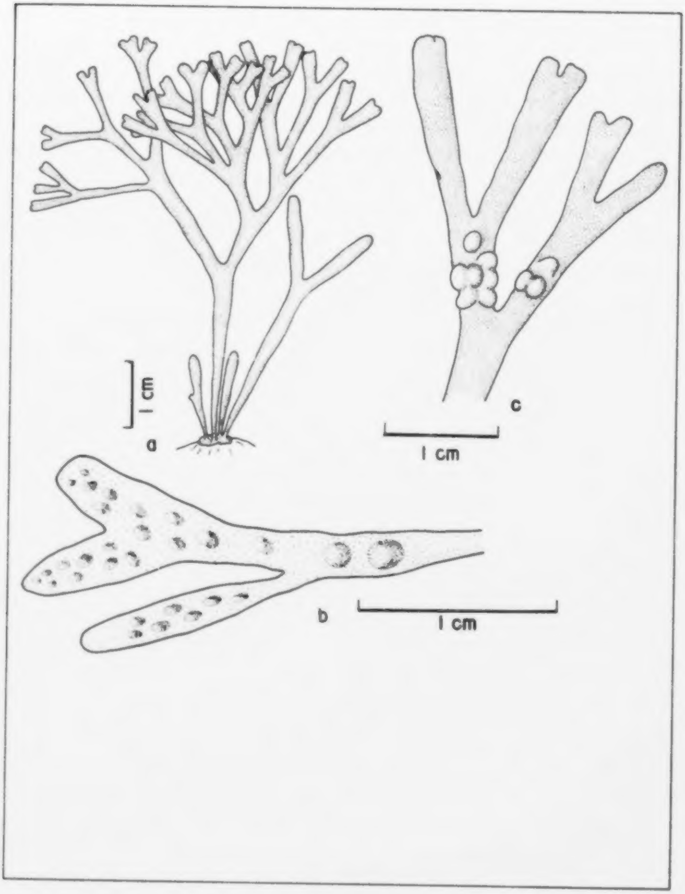


Fig. 102. *Gymnogongrus linearis* (Turner) J. Agardh. *a*, Habit of a cluster of plants attached to substrate; *b*, *c*, enlarged views of fertile portions of the plant.

Gymnogongrus platyphyllus Gardner

Description.—The plant (Fig. 103*a*) is erect, up to 15 cm. high, in clusters, attached to the substrate by a small discoid holdfast. The erect branches are firm in texture, dichotomously branched, and dull red to reddish purple in colour. The erect branches are dichotomously branched, lying in the same plane or twisted in various directions. Near the base the branches are cylindrical, but above they are markedly flattened (4–6 mm. wide) and less than 1 mm. thick. The medulla is made up of large angular cells, the cortex of laterally compacted filaments of small cells (Fig. 103*c*).

Habitat.—On rocks in the lower intertidal and upper subtidal zones.

Pacific Coast Distribution.—British Columbia to Mexico.

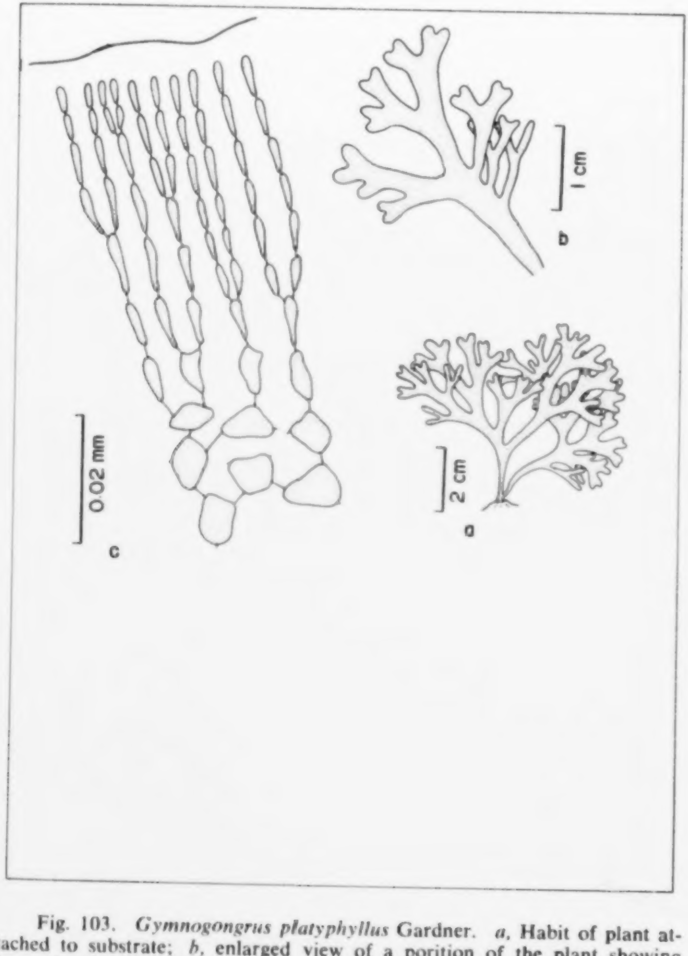


Fig. 103. *Gymnogongrus platyphyllus* Gardner. *a*, Habit of plant attached to substrate; *b*, enlarged view of a porition of the plant showing branching habit; *c*, transverse section of a portion of the plant showing arrangement of cells.

STENOGRAMME Harvey

Only one species of the genus *Stenogramme, S. interrupta* (C. Agardh) Montagne, which is described and illustrated here, is recorded from British Columbia.

Stenogramme interrupta (C. Agardh) Montagne

Description.—The plant (Fig. 104*a*) is erect, up to 22 cm. high, deep red in colour, and attached to the substrate by a small discoid holdfast. The erect portion is cylindrical at the extreme base, above flattened and dichotomously branched in linear segments up to 2 cm. wide. The tips of the branches are broadly rounded, and sometimes numerous small proliferous branchlets are present. The medulla (Fig. 104*b*) is made up of a few layers of large cubical cells, the cortex of a few layers of much smaller cubical cells.

Habitat.—On rocks in the subtidal zone to a depth of 5–10 fathoms.

Pacific Coast Distribution.—British Columbia to Mexico.

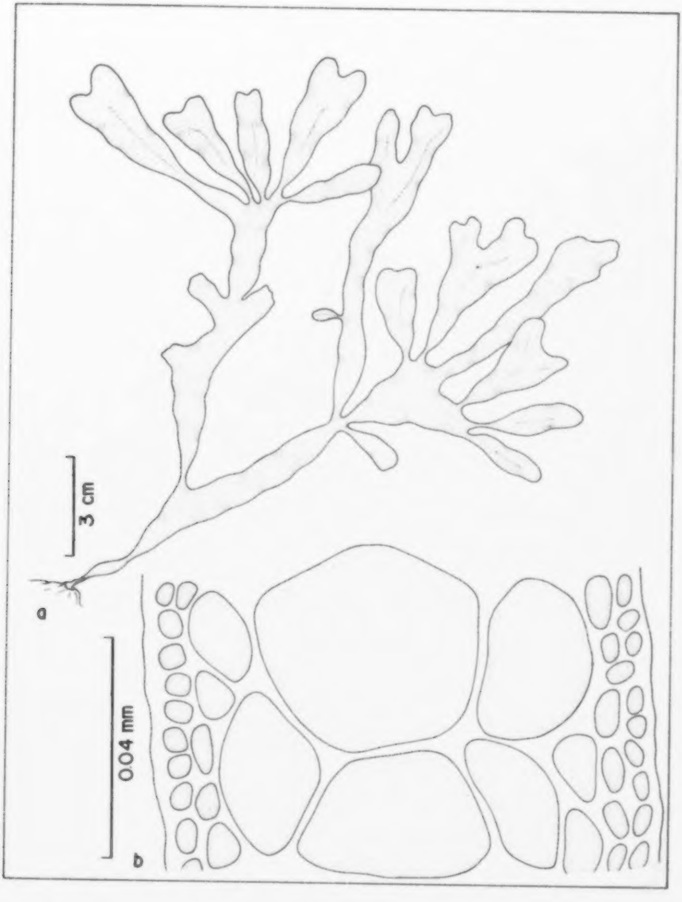


Fig. 104. *Stenogramme interrupta* (C. Agardh) Montagne. *a*, Habit of plant attached to substrate; *b*, transverse section of a portion of the plant showing arrangement of cells.

GIGARTINA Stackhouse

Ten species of the genus *Gigartina*—*G. binghamiæ* J. Agardh, *G. corymbifera* (Kützing) J. Agardh, *G. cristata* (Setchell) Setchell and Gardner, *G. exasperata* Harvey and Bailey, *G. latissima* (Harvey) Eaton, *G. mamillosa* (Goodenough and Woodward) J. Agardh, *G. papillata* (C. Agardh) J. Agardh, *G. sitchensis* Ruprecht, *G. stellata* (Stackhouse) Batters, and *G. unalaschcensis* (Ruprecht) Ruprecht—are recorded from British Columbia. Three of these, *G. cristata, G. exasperata,* and *G. latissima,* are described and illustrated here.

Gigartina cristata (Setchell) Setchell and Gardner

Description.—The plant is erect, up to 15 cm. high, dark reddish brown in colour, in clusters (Fig. 105*a*), attached to the substrate by a small discoid holdfast. The erect branches are flattened, with branching dichotomous (Fig. 105*b*). The flat dichotomies are generally narrow and often twisted. The surface of the plant is at first smooth, later developing many small papillate outgrowths (Fig. 105*c, d*). The medulla is made up of narrow interwoven colourless filaments; the cortex is made up of compacted filaments of cells, with progressively smaller cells toward the surface.

Habitat.—On rocks in the lower intertidal zone.

Pacific Coast Distribution.—British Columbia to Mexico.

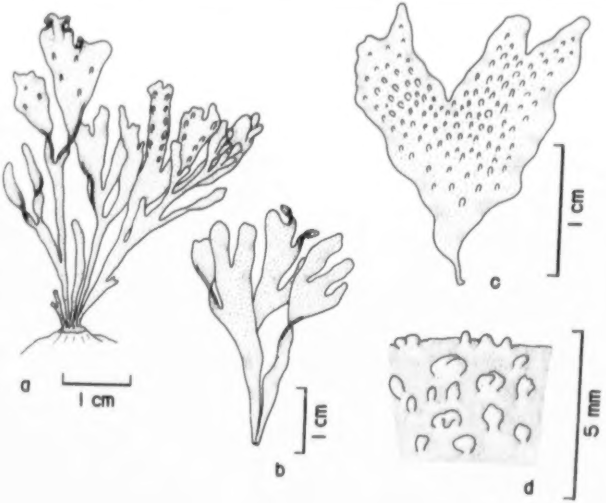


Fig. 105. *Gigartina cristata* (Setchell) Setchell and Gardner. *a*, Habit of a cluster of plants; *b*, *c*, habit, showing branching characteristics of individual plant without (*b*) and with (*c*) papillæ; *d*, enlarged surface view of a portion of the plant showing papillæ.

Gigartina exasperata Harvey and Bailey

Description.—The plant (Fig. 106*a*) is erect, up to 45 cm. high, wine red to purplish red in colour, often iridescent, markedly flattened, with an undivided blade or divided into a few broad irregular dichotomies. The base of the plant is narrowly stipitate and merges into a small discoid holdfast. The flattened blade is broadly rounded at the apex. The surfaces of the blade have numerous papillæ (Fig. 106*b*). The medulla is made up of narrow intertwined colourless filaments; the cortex is made up of compacted filaments of cells, with progressively smaller cells toward the surface.

Habitat.—On rocks in the lower intertidal and subtidal zones to a depth of 5–10 fathoms.

Pacific Coast Distribution.—British Columbia to California.

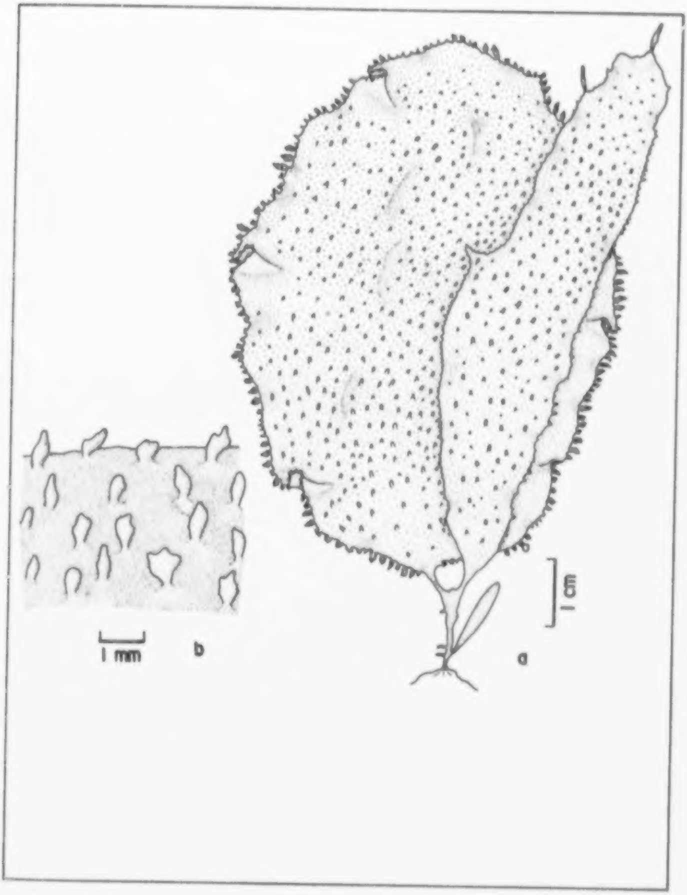


Fig. 106. *Gigartina exasperata* Harvey and Bailey. *a*, Habit of a plant attached to substrate; *b*, enlarged surface view of a portion of a plant showing papillæ.

Gigartina latissima (Harvey) Eaton

Description.—The plant is erect, up to 20 cm. high, dark reddish brown in colour, flattened throughout, undivided or divided into a few broad segments (Fig. 107*a*). Narrowly stipitate toward the base and attached in clusters by a small discoid holdfast. The blades are at first smooth, later developing numerous emergent papillæ on both surfaces. The medulla is made up of narrow intertwined colourless filaments; the cortex is made up of compacted cells, with progressively smaller cells toward the surface.

Habitat.—On rocks in the intertidal zone.

Pacific Coast Distribution.—British Columbia to Washington.

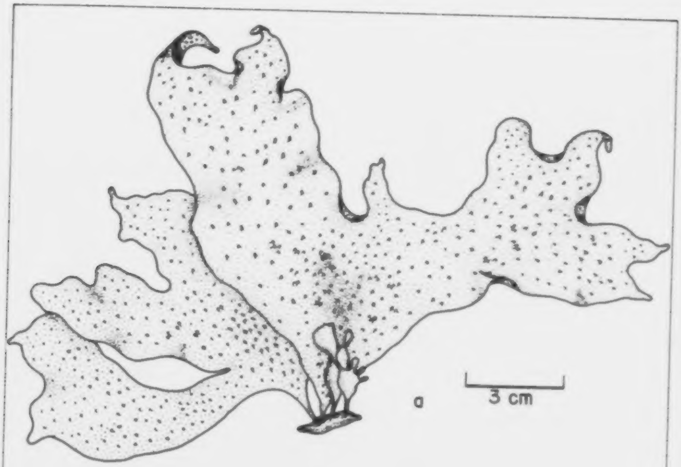


Fig. 107. *Gigartina latissima* (Harvey) Eaton. *a*, Habit of a cluster of plants attached to the substrate, showing branching characteristics and papillæ.

RHODOGLOSSUM J. Agardh

Two species of the genus *Rhodoglossum*—*R. affine* (Harvey) Kylin and *R. latissimum* J. Agardh, both of which are described and illustrated here—are recorded from British Columbia.

Rhodoglossum affine **(Harvey) Kylin**

Description.—The plant (Fig. 108*a*) is erect, up to 15 cm. tall, olive brown to reddish purple in colour, usually in tufts, attached to the substrate by a small discoid holdfast. It is narrowly stipitate below, and dichotomously divided above into narrow flat branches of more or less uniform width (up to about 2 cm. wide) throughout. Margins of distal portion of flattened branches frequently possess small proliferous branches. The medulla is made up of interwoven colourless longitudinal filaments; the cortex (Fig. 108*d*) is made up of compact branching filaments of small cells, with progressively smaller cells toward the surface.

Habitat.—On rocks in the lower intertidal zone.

Pacific Coast Distribution.—Alaska to Mexico.

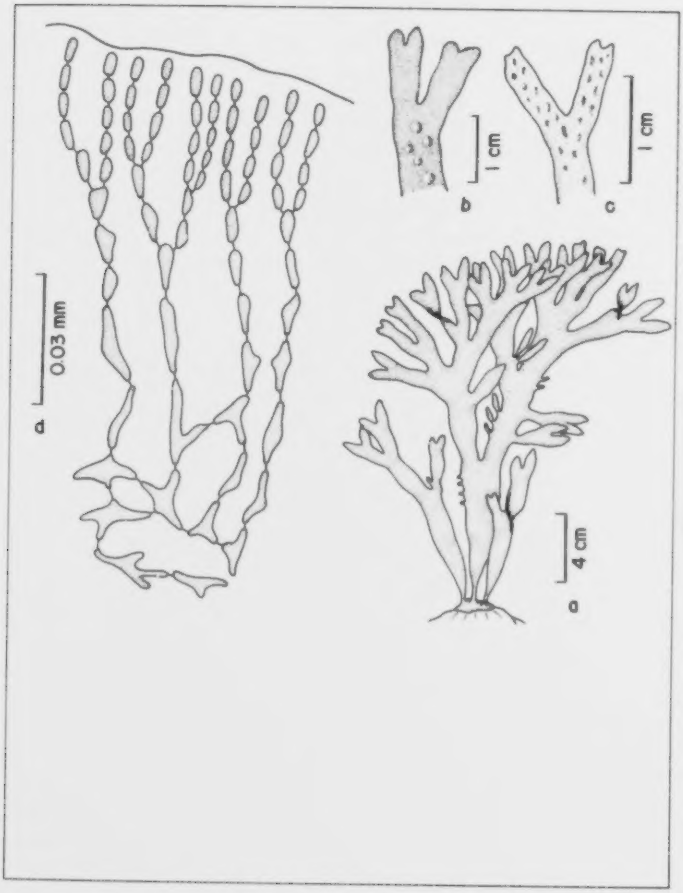


Fig. 108. *Rhodoglossum affine* (Harvey) Kylin. *a*, Habit of a cluster of plants; *b*, *c*, enlarged views of fertile portions of cystocarpic (*b*) and tetrasporangiate (*c*) plants; *d*, transverse section of a portion of the plant showing arrangement of cells.

Rhodoglossum latissimum J. Agardh

Description.—The plant (Fig. 109*a*) is erect, up to 30 cm. tall, thin and blade-like, reddish purple in colour, attached to the substrate by a small discoid holdfast. The plant is stipitate at the base, tapering abruptly to a broad simple linear to lanceolate blade. The medulla is made up of interwoven colourless longitudinal filaments; the cortex (Fig. 109*d*) is made up of compact branching filaments of cells, with progressively smaller cells toward the surface.

Habitat.—On rocks in the lower intertidal and subtidal zones.

Pacific Coast Distribution.—Alaska to Washington.

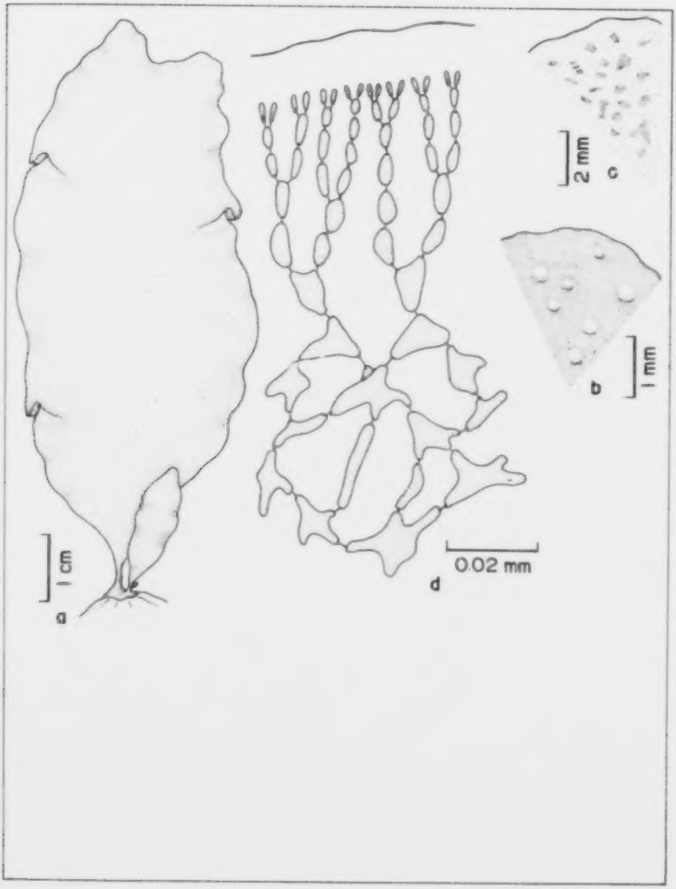


Fig. 109. *Rhodoglossum latissimum* J. Agardh. *a*, Habit of a plant attached to the substrate; *b*, *c*, enlarged surface views of fertile regions of cystocarpic (*b*) and tetrasporangiate (*c*) plants; *d*, transverse section of a portion of the plant showing arrangement of cells.

IRIDÆA Bory

Six species of the genus *Iridæa*—*I. latissimum* J. Agardh, *I. cordata* (Turner) Bory, *I. coriacea* (Setchell and Gardner) Scagel, *I. heterocarpa* Postels and Ruprecht, *I. lineare* (Setchell and Gardner) Kylin, and *I. whidbeyana* (Setchell and Gardner) Kylin—are recorded from British Columbia. Two of these, *I. lineare* and *I. cordata*, are described and illustrated here.

Iridæa cordata **(Turner) Bory**

Description.—The plant is erect, up to 30 cm. high, growing in clusters (Fig. 110*a*), brownish red to reddish purple in colour, usually iridescent, and attached to the substrate by a small discoid holdfast. The blade is usually undivided, but sometimes it is irregularly divided into broad segments. The basal portion of the blade is a short narrow stipe, tapering into a broad flat linear blade with ruffled margins. The blade is thick and cartilaginous. The medulla is made up of interwoven colourless filaments; the cortex is made up of filaments of smaller cells, with progressively smaller cells toward the surface (Fig. 110*b*).

Habitat.—On rocks in the lower intertidal and upper subtidal zones.

Pacific Coast Distribution.—British Columbia to Oregon.

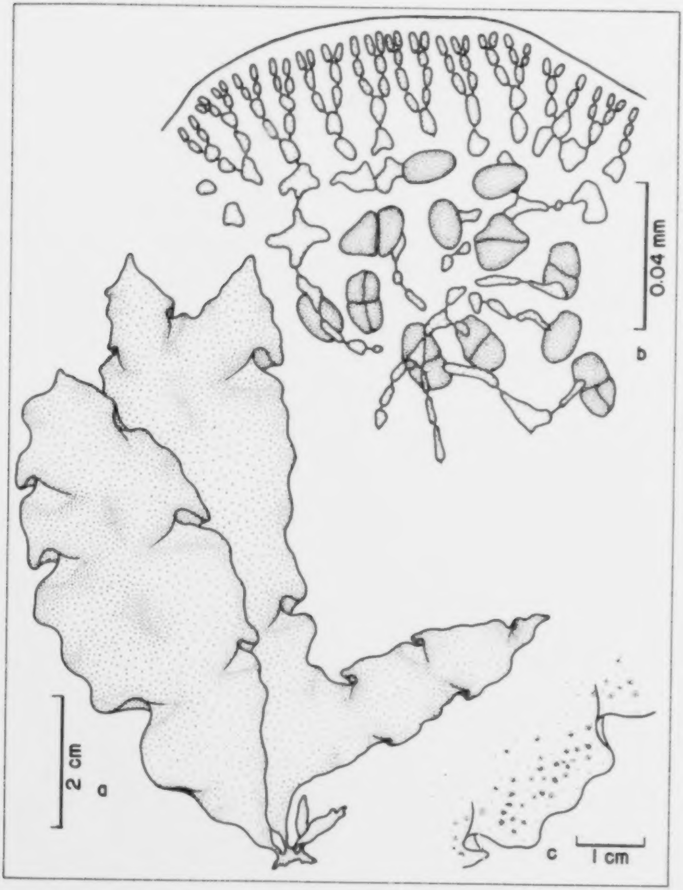


Fig. 110. *Iridæa cordata* (Turner) Bory. *a*, Habit of cluster of plants; *b*, enlarged view of a fertile portion of the plant; *c*, transverse section of fertile portion of a plant showing arrangement of vegetative cells and tetrasporangia.

Iridæa lineare (Setchell and Gardner) Kylin

Description.—The plant (Fig. 111*a, c*) is erect, up to 60 cm. high, growing in clusters, brownish red to reddish purple in colour, and attached to the substrate by a small discoid holdfast. The blade is usually undivided, but sometimes is irregularly divided into broad segments. The basal portion of the plant is stipitate, and the cylindrical stipe, which is up to 5 cm. long, tapers gradually into an elongate flattened blade; the blade is linear to lanceolate in shape, up to 7 cm. broad, and tapers to an acute apex. The blades tend to be spirally twisted, and the margins are generally slightly ruffled. The medulla is made up of interwoven colourless longitudinal filaments; the cortex is made up of filaments of smaller cells, with progressively smaller cells toward the surface.

Habitat.—On rocks in the lower intertidal zone.

Pacific Coast Distribution.—British Columbia to California.

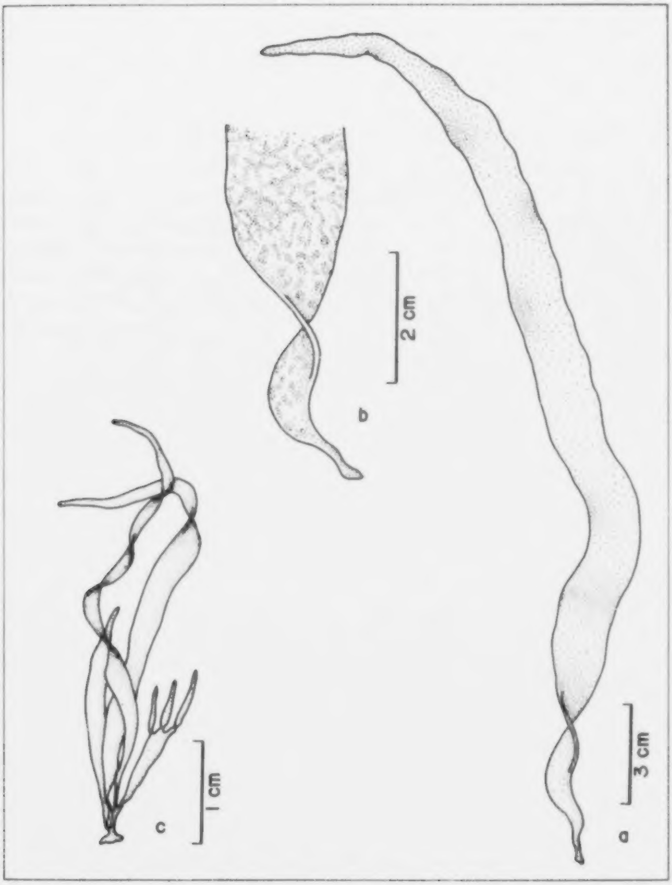


Fig. 111. *Iridæa lineare* (Setchell and Gardner) Kylin. *a, c,* Habit of unbranched and branched forms of the plant; *b,* enlarged view of a fertile (tetrasporangiate) portion of a plant.

BOTRYOCLADIA Kylin

Only one species of the genus *Botryocladia*, ***B**. pseudodichotoma* (Farlow) Kylin, which is described and illustrated here, is recorded from British Columbia.

Botryocladia pseudodichotoma **(Farlow) Kylin**

Description.—The plant (Fig. 112*a*) is erect, up to 15 cm. tall, rose red in colour, attached securely to the substrate by a small discoid holdfast. The plant is irregularly dichotomous, with narrow solid cylindrical branches, each terminating in a hollow spherical to pyriform vesicle up to 7 cm. long and 3 cm. broad. The vesicle is filled with a thick slimy material. The medullary cells (next to cavity in hollow vesicle) are large, and the cortex has progressively smaller cells toward the surface (Fig. 112*b*).

Habitat.—On rocks in the subtidal zone to a depth of 5–10 fathoms.

Pacific Coast Distribution.—British Columbia to Mexico.

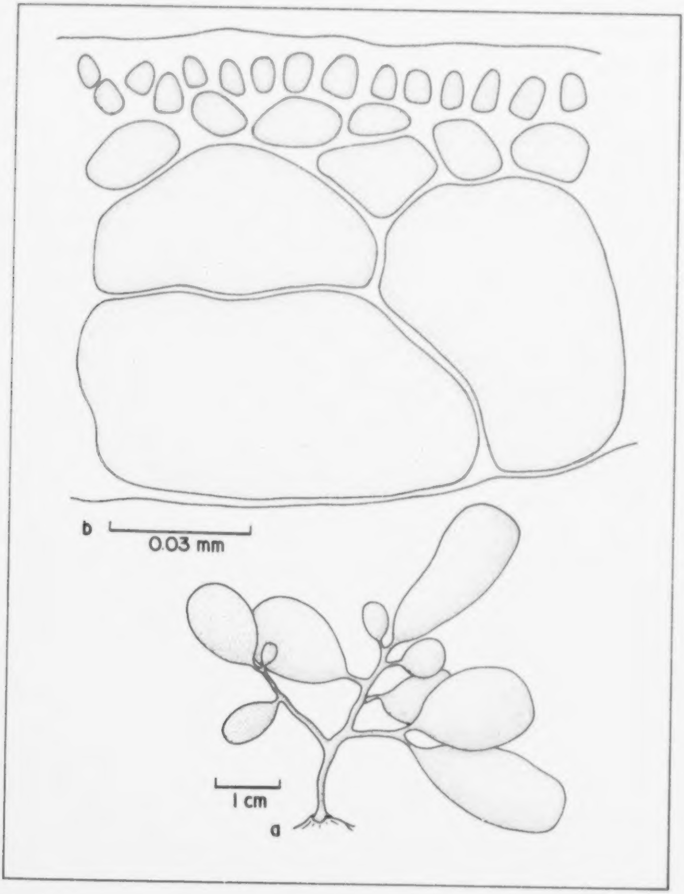


Fig. 112. *Botryocladia pseudodichotoma* (Farlow) Kylin. *a*, Habit of a plant fastened to the substrate, showing branching habit; *b*, transverse section of a vegetative portion of the plant showing arrangement of cells.

HALOSACCION Kützing

Only one species of the genus *Halosaccion, H. glandiforme* (Gmelin) Ruprecht, which is described and illustrated here, is recorded from British Columbia.

Halosaccion glandiforme **(Gmelin) Ruprecht**

Description.—The plant (Fig. 113*b*) is erect, up to 30 cm. high, generally in clusters (Fig. 113*a*), yellowish brown, olive brown, or reddish purple in colour, attached to the substrate by a small discoid holdfast. The erect portion is an elongate hollow sac, up to 4 cm. in diameter, tapering abruptly to a narrow stipitate region below, and broadly rounded at the apex. The hollow saccate region is filled with water. The saccate portion has a medulla made up of colourless cells (next to the hollow cavity), and these merge with progressively smaller cells toward the surface (Fig. 113*c*).

Habitat.—On rocks in the middle intertidal zone.

Pacific Coast Distribution.—Alaska to Mexico.

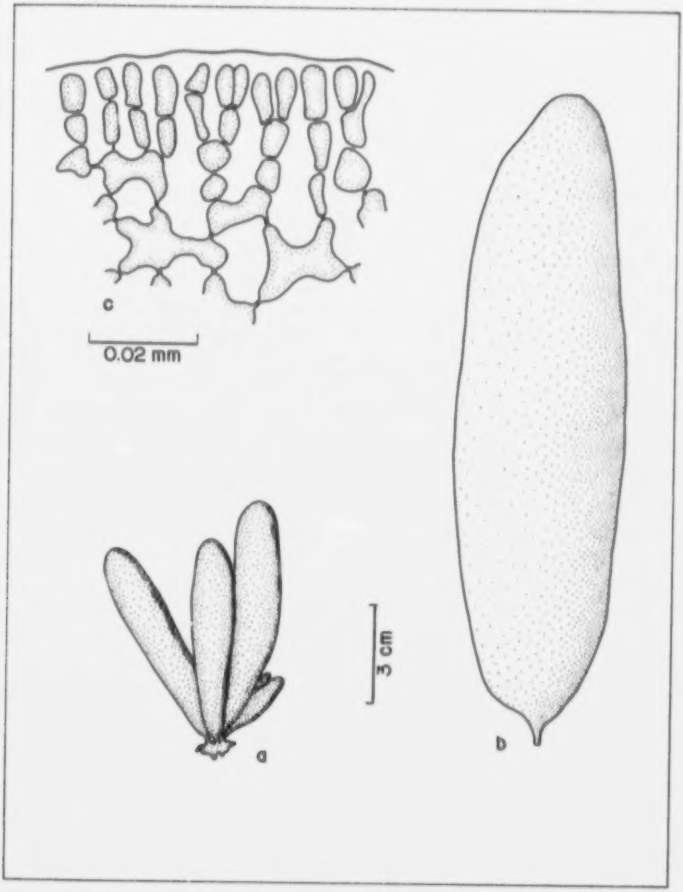


Fig. 113. *Halosaccion glandiforme* (Gmelin) Ruprecht. *a*, Habit of a cluster of plants attached to substrate; *b*, a single plant; *c*, transverse section of a vegetative portion of the plant showing arrangement of cells.

RHODYMENIA Greville

Five species of the genus *Rhodymenia* — *R. californica* Kylin, *R. pacifica* Kylin, *R. palmata* (L.) Greville, *R. pertusa* (Postels and Ruprecht) J. Agardh, and *R. stipitata* Kylin — are recorded from British Columbia. Two of these, *R. palmata* and *R. pertusa,* are described and illustrated here.

Rhodymenia palmata **(L.) Greville**

Description.—The plant (Fig. 114*a*) is erect, up to 40 cm. high, brownish red to reddish purple in colour, usually in clusters, attached to the substrate by a small discoid holdfast. The erect portion has a short inconspicuous stipe which merges into a broad, flat dichotomously divided blade. The dichotomies are up to 30 cm. wide and often possess numerous small proliferous marginal bladelets. The medulla (Fig. 114*b*) is made up of large compactly organized cubical colourless cells. The cortex (Fig. 114*b*) is a few cells thick, with smaller cubical cells becoming progressively smaller toward the surface.

Habitat.—On rocks in the upper subtidal zone.

Pacific Coast Distribution.—Alaska to California.

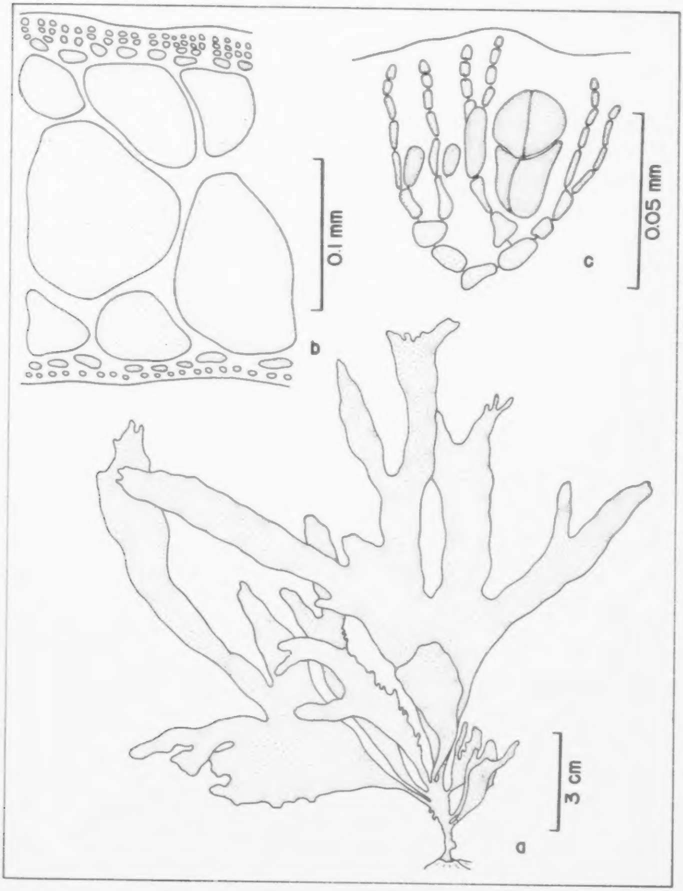


Fig. 114. *Rhodymenia palmata* (L.) Greville. *a*, Habit of plant attached to substrate; *b*, transverse section of a vegetative portion of the plant showing arrangement of cells; *c*, transverse section of a fertile region of the plant showing tetrasporangia and associated vegetative cells near the surface.

Rhodymenia pertusa (Postels and Ruprecht) J. Agardh

Description.—The plant (Fig. 115*a*) is erect, up to 1 m. tall, usually simple, but sometimes divided into broad segments, rose red in colour and attached to the substrate by a small discoid holdfast. The erect portion of the plant has a short cylindrical stipe that merges into a thin broad flat blade up to 30 cm. wide. The blade is generally perforate. Sometimes proliferous bladelets arise near the basal portion of the stipe. The medulla (Fig. 115*b*) is made up of large colourless cubical cells, which merge with small cells that are progressively smaller toward the surface.

Habitat.—On rocks in the subtidal zone to a depth of 5–10 fathoms.

Pacific Coast Distribution.—Alaska to Oregon.

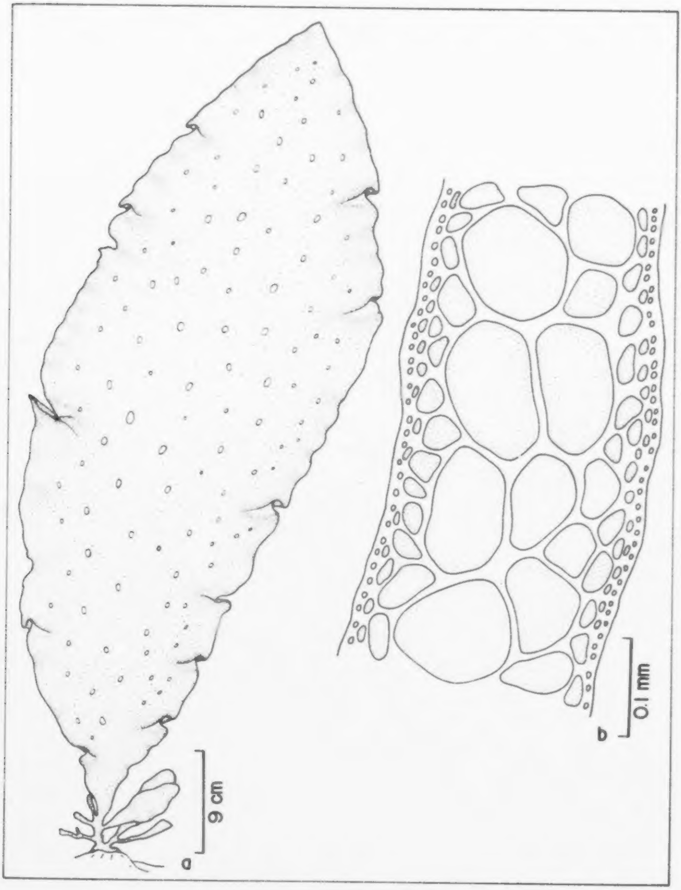


Fig. 115. *Rhodymenia pertusa* (Postels and Ruprecht) J. Agardh. *a*, Habit of plant attached to substrate, showing perforated blade; *b*, transverse section of a vegetative portion of a plant showing arrangement of cells.

GASTROCLONIUM Kützing

Only one species of the genus *Gastroclonium, G. coulteri* (Harvey) Kylin, which is described and illustrated here, is recorded from British Columbia.

Gastroclonium coulteri (Harvey) Kylin

Description.—The plant (Fig. 116*a*) is erect, up to 25 cm. tall, generally in clusters, olive brown in colour, attached to the substrate by a small discoid holdfast. The erect portion of the plant is irregularly dichotomously branched, with cylindrical axes which are devoid of branchlets below and above clothed with numerous short lateral branchlets up to 2 cm. long. The branchlets (Fig. 116*b*) are slightly constricted at the base and at regular intervals, and broadly rounded at the apex. The main axes are solid, but the interior of the branchlets is hollow and transversely septate. The medulla (next to the hollow region in the branchlets) is made up of elongate filaments; the cortex is made up of small cells that are progressively smaller toward the surface.

Habitat.—On rocks in the lower intertidal and upper subtidal zones.

Pacific Coast Distribution.—Alaska to Mexico.

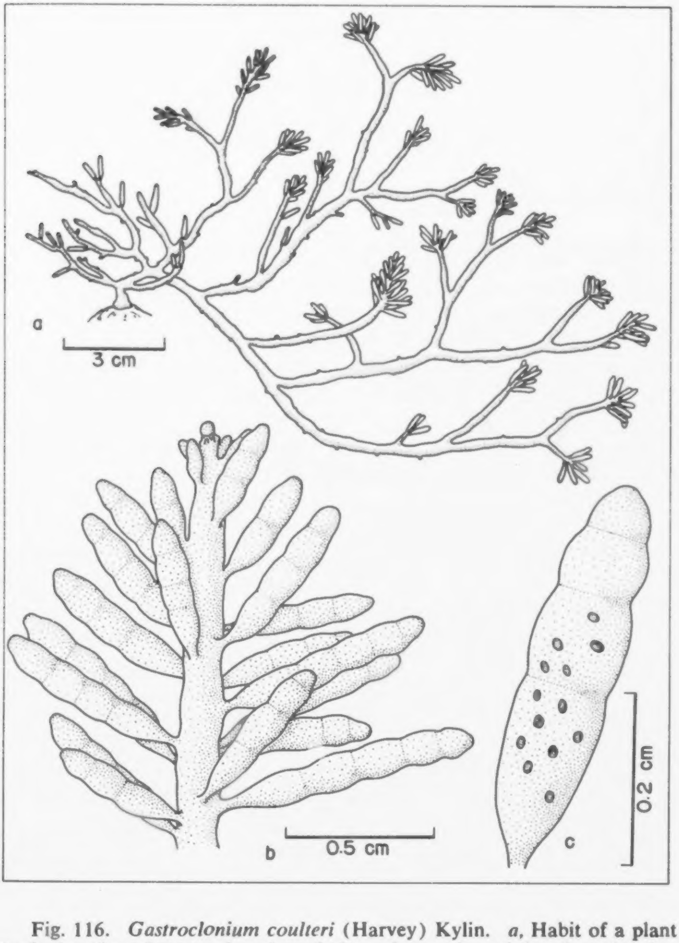


Fig. 116. *Gastroclonium coulteri* (Harvey) Kylin. *a*, Habit of a plant attached to the substrate; *b*, enlarged view of a portion of the plant showing branching habit; *c*, enlarged surface view of a fertile portion of the plant showing tetrasporangia.

ANTITHAMNION Nägeli

Ten species of the genus *Antithamnion* — *A. defectum* Kylin, *A. densiusculum* Gardner, *A. floccosum* (Müller) Kleen, *A. glanduliferum* Kylin, *A. kylinii* Gardner, *A. nigricans* Gardner, *A. occindentale* Kylin, *A. pacificum* (Harvey) Kylin, *A. subulatum* (Harvey) J. Agardh, and *A. uncinatum* Gardner—are recorded from British Columbia. One of these, *A. pacificum* is described and illustrated here.

Antithamnion pacificum (Harvey) Kylin

Description.—The plant (Fig. 117*a*) is erect, up to 15 cm. tall, rose red in colour, profusely branched, attached to the substrate by a rhizoidal holdfast. The main axes are obscure, with numerous major branches and a branchlet opposite each major branch. The main branches (Fig. 117*b*) have an opposite pair of branchlets at the upper end of each cell. The branches are uniseriate and uncorticated throughout. The branchlets are simple and curved toward the apex of branch bearing them.

Habitat.—On piling and epiphytic on other algæ, especially the stipe of *Nereocystis,* in the subtidal zone.

Pacific Coast Distribution.—Adak Island, Alaska, to Mexico.

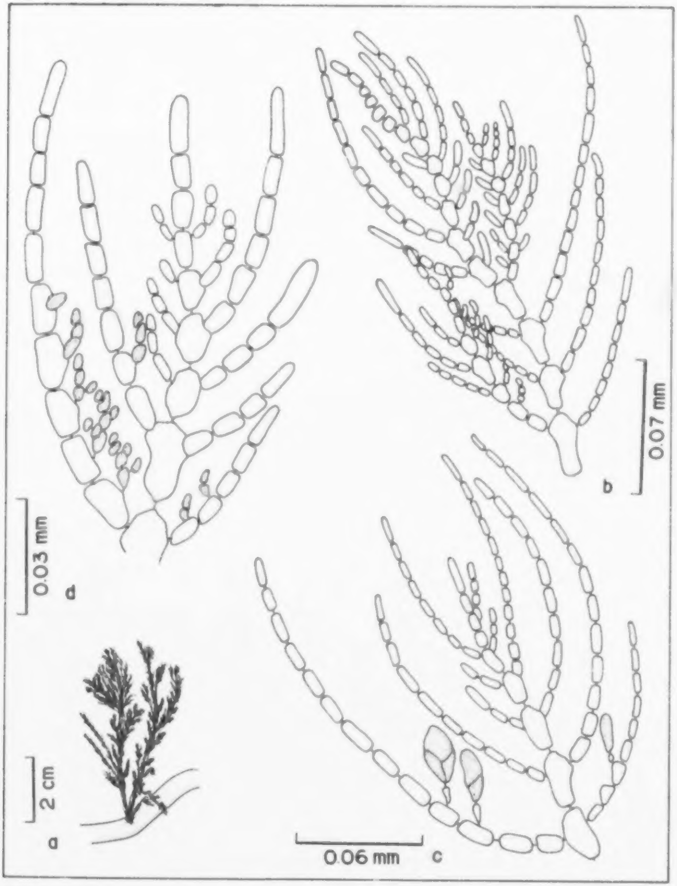

0.03 mm
d
0.07 mm
b
2 cm
a
0.06 mm
c

Fig. 117. *Antithamnion pacificum* (Harvey) Kylin. *a*, Habit of plant attached to portion of stipe of *Nereocystis; b, c, d*, enlarged views of portions of the vegetative (*b*), tetrasporangiate (*c*), and male (*d*) plants.

CALLITHAMNION Lyngbye

Five species of the genus *Callithamnion* — *C. acutum* Kylin, *C. biseriatum* Kylin, *C. bisporm* Gardner, *C. laxum* Setchell and Gardner, and *C. pikeanum* Harvey — are recorded from British Columbia. One of these, *C. pikeanum,* is described and illustrated here.

Callithamnion pikeanum **Harvey**

Description.—The plant (Fig. 118*d*) is erect, up to 40 cm. tall, profusely branched, brownish purple in colour, attached to the substrate by a small discoid holdfast. The main axes are conspicuous, corticated (Fig. 118*a*) from base to apex, and give rise on all sides to several orders of short branchlets, the last order of which is uniseriate and uncorticated. The branchlets are recurved and acutely pointed at the apices.

Habitat.—On rocks in the middle and lower intertidal zone.

Pacific Coast Distribution.—Alaska to California.

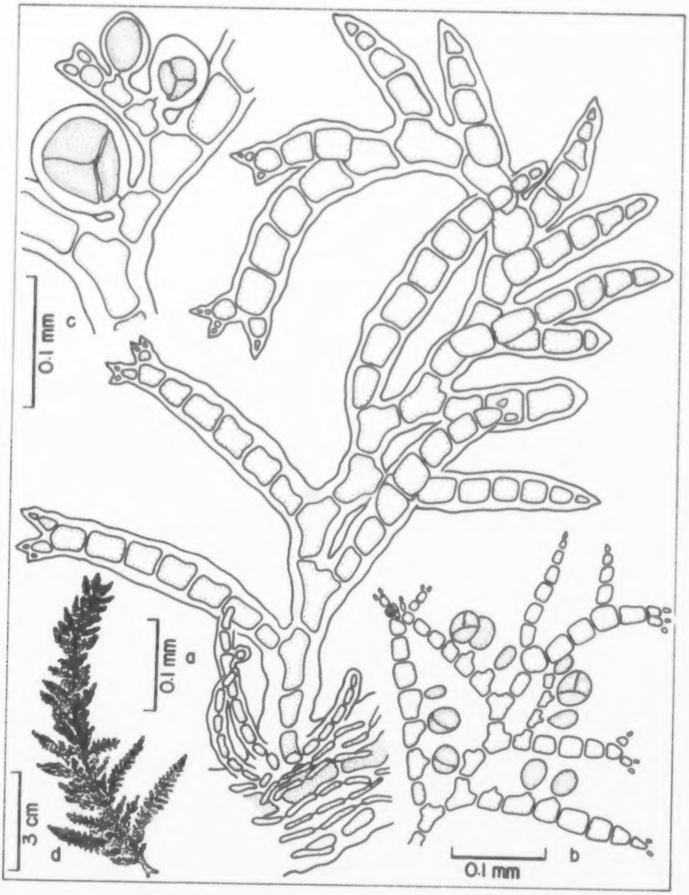

0.1 mm
c
0.1 mm
a
3 cm
d
0.1 mm
b

Fig. 118. *Callithamnion pikeanum* Harvey. *a*, Enlarged view of a vegetative portion of the plant showing branching habit; *b*, habit of plant; *c*, *d*, enlarged views of fertile region of plant showing tetrasporangia.

CERAMIUM Roth

Six species of the genus *Ceramium*—*C. californicum* J. Agardh, *C. codicola* J. Agardh, *C. pacificum* (Collins) Kylin, *C. rubrum* (Hudson) C. Agardh, *C. strictum* Harvey, and *C. washingtoniense* Kylin—are recorded from British Columbia. Two of these, *C. californicum* and *C. pacificum*, are described and illustrated here.

Ceramium californicum J. Agardh

Description.—The plant (Fig. 119*a*) is erect, up to 6 cm. tall, rose red in colour. The main axes are cylindrical, irregularly dichotomously to alternately branched, with prominent cortical bands (Fig. 119*b*) of cells at intervals alternating with uncorticated regions. The central axis is composed of a uniseriate row of large cells. The branch apices are forcipate (Fig. 119*c*).

Habitat.—Epiphytic on other algæ, including *Agardhiella* and *Gracilariopsis*, in the lower intertidal and upper subtidal zones.

Pacific Coast Distribution. — Southern British Columbia to Mexico.

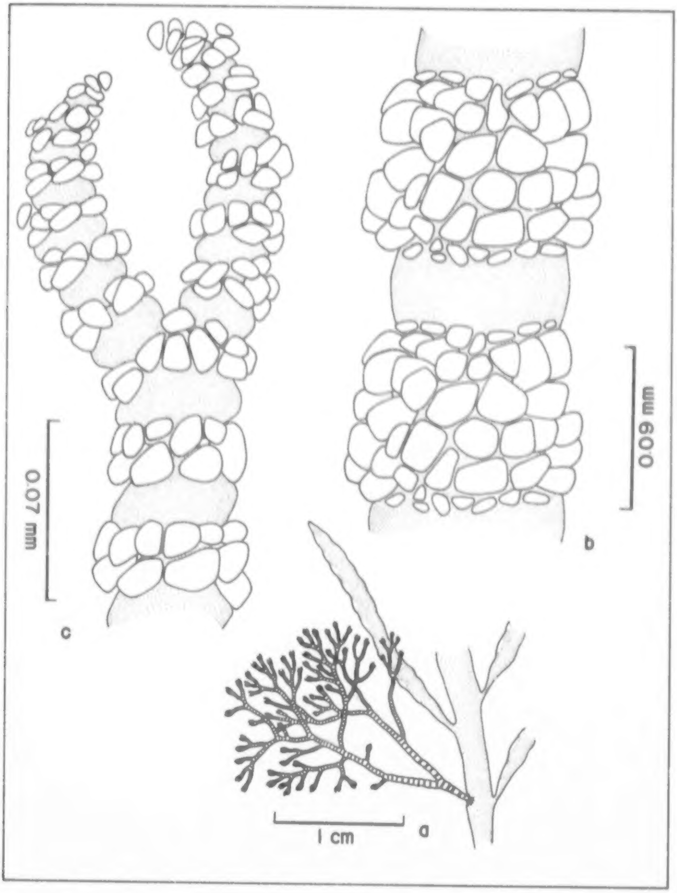


Fig. 119. *Ceramium californicum* J. Agardh. *a,* Habit of plant attached to a portion of a plant of *Agardhiella; b, c,* enlarged surface views of portions of the plant showing arrangement of cells.

Ceramium pacificum (Collins) Kylin

Description.—The plant (Fig. 120*a*) is erect, up to 18 cm. tall, deep red in colour. The main axes are cylindrical, dichotomously branched, with branches terminating in forcipate tips (Fig. 120*d*). The branches bear numerous short simple or branched branchlets. The branches are completely corticated (Fig. 120*c*).

Habitat.—On rocks in the lower intertidal zone.

Pacific Coast Distribution. — Northern British Columbia to Mexico.

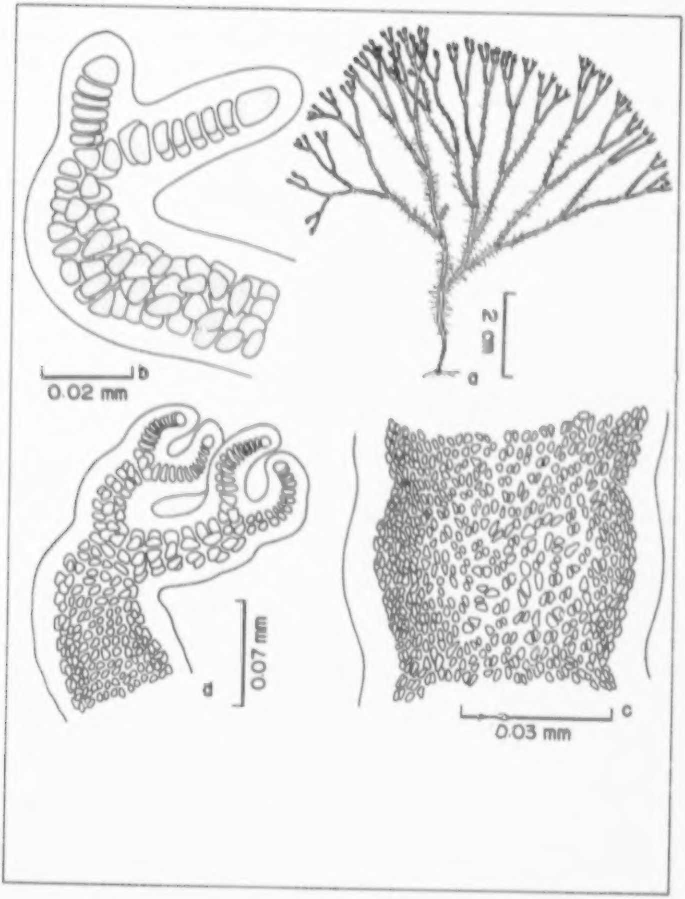

b
0.02 mm
2 cm
a
0.07 mm
d
c
0.03 mm

Fig. 120. *Ceramium pacificum* (Collins) Kylin. *a*, Habit of plant attached to substrate; *b*, *c*, *d*, enlarged views of portion of the plant showing arrangement of cells in main axis (*c*) and at the branch apices (*b*, *d*).

MICROCLADIA Greville

Two species of the genus *Microcladia*—*M. borealis* Ruprecht and *M. coulteri* Harvey—are recorded from British Columbia, and both are described and illustrated here.

Microcladia borealis **Ruprecht**

Description.—The plant (Fig. 121*a*) is erect, up to 18 cm. high, profusely branched, brownish red to deep red in colour, generally in tufts, attached to the substrate by a system of rhizoidal branches. The erect branches are somewhat flattened and have successive orders of unilateral pectinate branching (Fig. 121*b*). The ultimate orders of branching have branchlets curving toward the axis (Fig. 121*c*). The tips of the branches are forcipate. The plant axis is made up of a uniaxial filament of elongate large cells surrounded by a cortex of irregularly shaped small cells which is several cells thick in the mature portions of the plant.

Habitat.—On rocks in the upper intertidal zone.

Pacific Coast Distribution.—Attu Island, Alaska, to California.

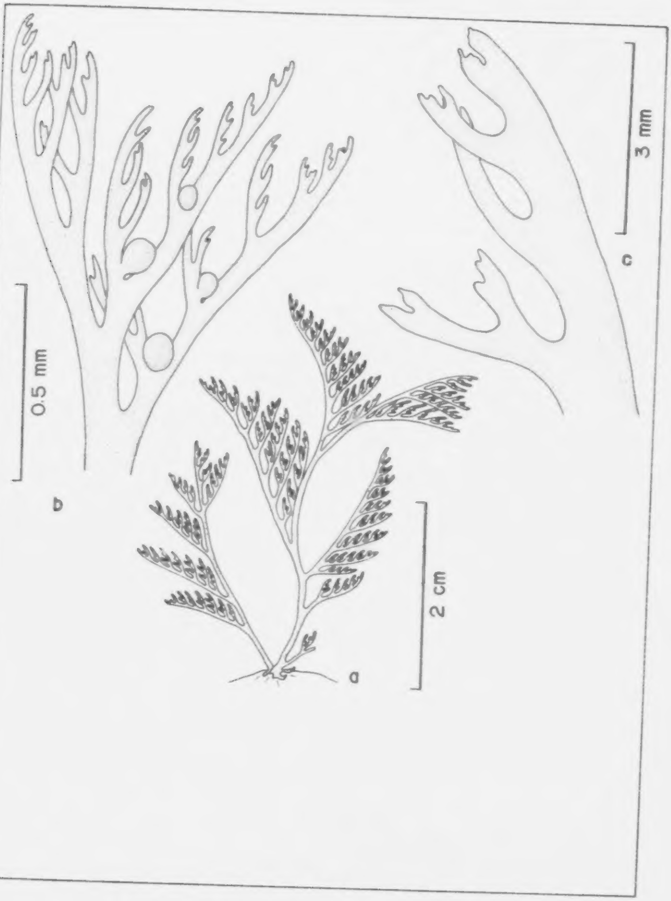


Fig. 121. *Microcladia borealis* Ruprecht. *a*, Habit of plant attached substrate; *b*, enlarged view of a fertile portion of the plant showing stocarps; *c*, enlarged view of a vegetative region of the plant showing anching habit.

***Microcladia coulteri* Harvey**

Description.—The plant (Fig. 122*a*) is erect, up to 35 cm. high, rose red in colour, attached epiphytically to the substrate by an embedded irregularly branched holdfast. The erect portion has a percurrent axis repeatedly branched into several orders of somewhat flattened branches (Fig. 122*a*), with branching regularly alternate and distichous and all lying in the same plane. Ultimate branchlets (Fig. 122*b*) are curved toward the axes and possess forcipate tips. The plant axis is made up of a uniaxial filament of elongate large cells surrounded by a cortex of irregularly shaped small cells which is several cells thick in a mature portion of the plant.

Habitat.—Epiphytic on various red algæ, especially species of *Gigartina, Prionitis,* and *Grateloupia,* in the lower intertidal and upper subtidal zones.

Pacific Coast Distribution.—Alaska to Mexico.

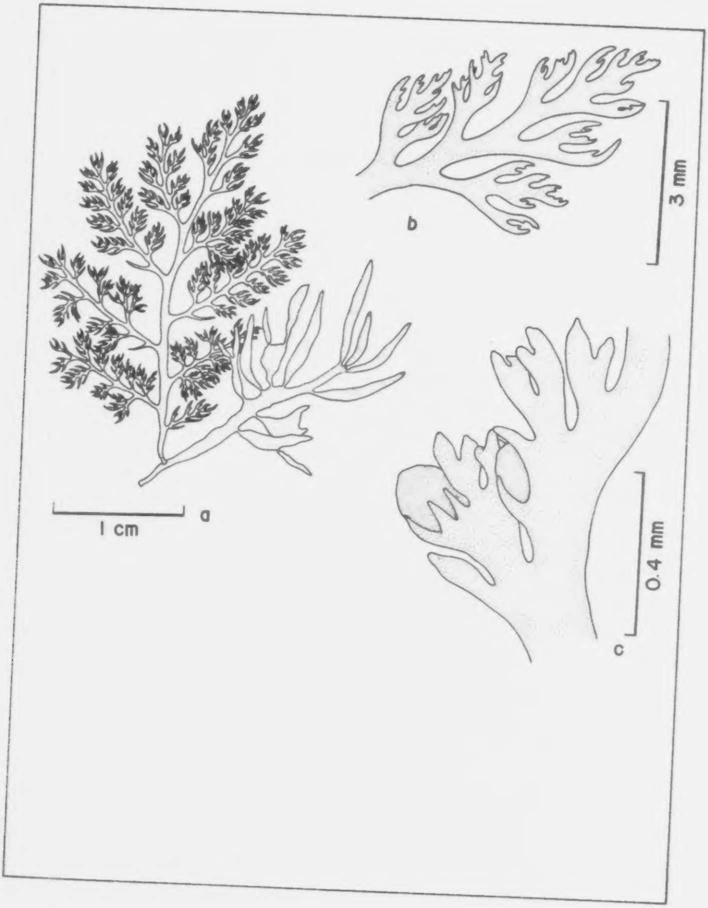


Fig. 122. *Microcladia coulteri* Harvey. *a*, Habit of plant growing epiphytically on *Prionitis; b*, enlarged view of vegetative portion of plant showing branching habit; *c*, enlarged view of fertile region of plant showing swollen cystocarps.

PTILOTA C. Agardh

Six species of the genus *Ptilota* — *P. asplenioides* (Esper) C. Agardh, *P. californica* (Ruprecht) Kylin, *P. filicina* (Farlow) J. Agardh, *P. hypnoides* Harvey, *P. pectinata* (Gunner) Kjellman, and *P. tenuis* Kylin — are recorded from British Columbia. Three of these, *P. asplenioides, P, hypnoides,* and *P. tenuis,* are described and illustrated here.

Ptilota asplenioides (Esper) C. Agardh

Description.—The plant (Fig. 123*a*) is erect, up to 30 cm. tall, deep red in colour, in clusters, attached to the substrate by a small discoid holdfast. The main axes are distinct, compressed, and bear several orders of progressively smaller branchlets. Short unbranched branchlets (Fig. 123*b*) occur singly opposite each branched branchlet along the axes, and these tend to be distichous and lie in one plane. .These branch pairs alternate regularly along the axis. The ultimate branchlets (Fig. 123*c*) are linear to lanceolate in shape, markedly flattened, with more or less dentate margins, and curve slightly toward the axis from which they arise. The apices of the teeth are blunt. The plant has a central axial filament of cells which is surrounded by one or more layers of small corticating cells.

Habitat.—Epiphytic on other red algæ in the upper subtidal zone.

Pacific Coast Distribution.—Alaska to Northern Washington.

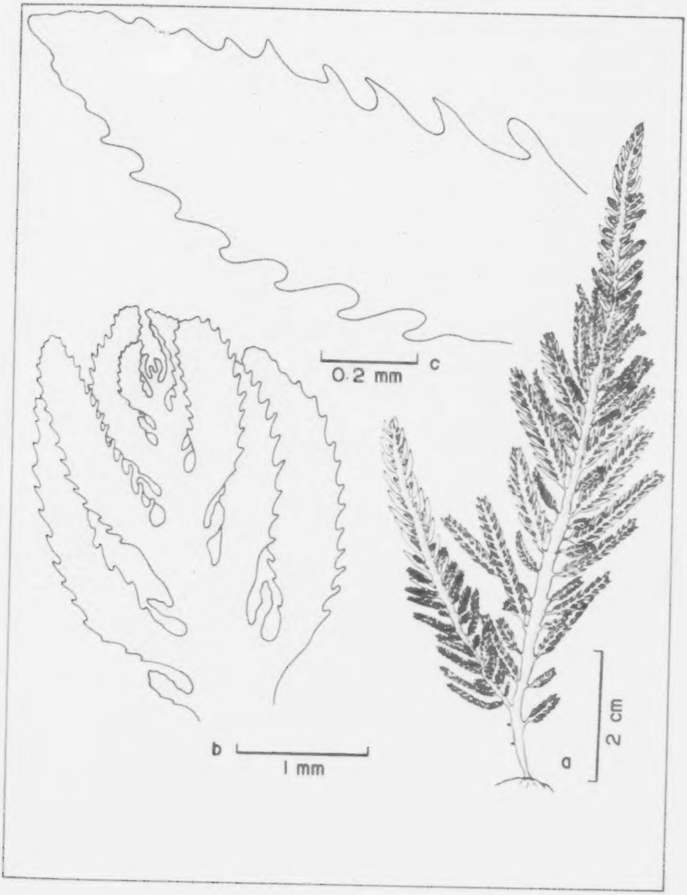


Fig. 123. *Ptilota asplenioides* (Esper) C. Agardh. *a*, Habit of plant fastened to substrate; *b*, *c*, enlarged view of portions of the plant showing branching habit.

***Ptilota hypnoides* Harvey**

Description.—The plant (Fig. 124*a*) is erect, up to 25 cm. high, blackish red in colour, in clusters, attached to the substrate by a small discoid holdfast. The main axes are distinct, compressed, and bear several orders of progressively smaller branchlets. Short unbranched branchlets occur singly opposite each branched branchlet along the axes, and these tend to be distichous and lie in one plane. These branch pairs (Fig. 124*b*) alternate regularly along the axis. The ultimate branches (Fig. 124*c*) are linear to lanceolate in shape and curve toward the axis from which they arise. The plant has a central axial filament of cells which is surrounded by one or more layers of small corticating cells.

Habitat.—Epiphytic on other algæ, especially species of *Calliarthron,* a coralline alga, in the lower intertidal zone.

Pacific Coast Distribution.—Alaska to California.

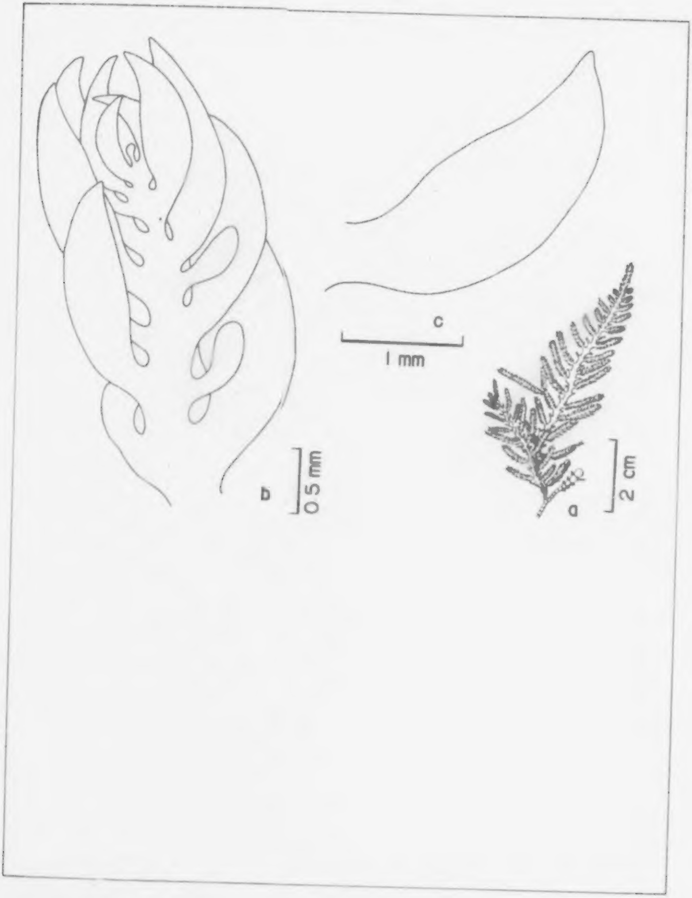


Fig. 124. *Ptilota hypnoides* Harvey. *a*, Habit of plant growing epiphytically on an articulated coralline alga; *b*, *c*, enlarged views of portions of the plant showing branching habit.

Ptilota tenuis **Kylin**

Description.—The plant (Fig. 125*a*) is erect, up to 10 cm. high, profusely branched, brownish red to dark red in colour, in clusters, attached to the substrate by a small discoid holdfast. The main axes are distinct, compressed, and bear several orders of progressively smaller branchlets. Short unbranched branchlets occur singly opposite each branched branchlet (Fig. 125*b*) along the axes, and these tend to be distichous and lie in one plane. These branch pairs alternate regularly along the axis. The ultimate branches (Fig. 125*c*) are linear to lanceolate in shape, markedly flattened, with deeply serrate margins, and curve slightly inward toward the axis from which they arise. The apices of the teeth are acute. The plant has a central axial filament of cells which is surrounded by one or more layers of small corticating cells.

Habitat.—On rocks in the lower intertidal zone.

Pacific Coast Distribution. — Northern British Columbia to Northern Washington.

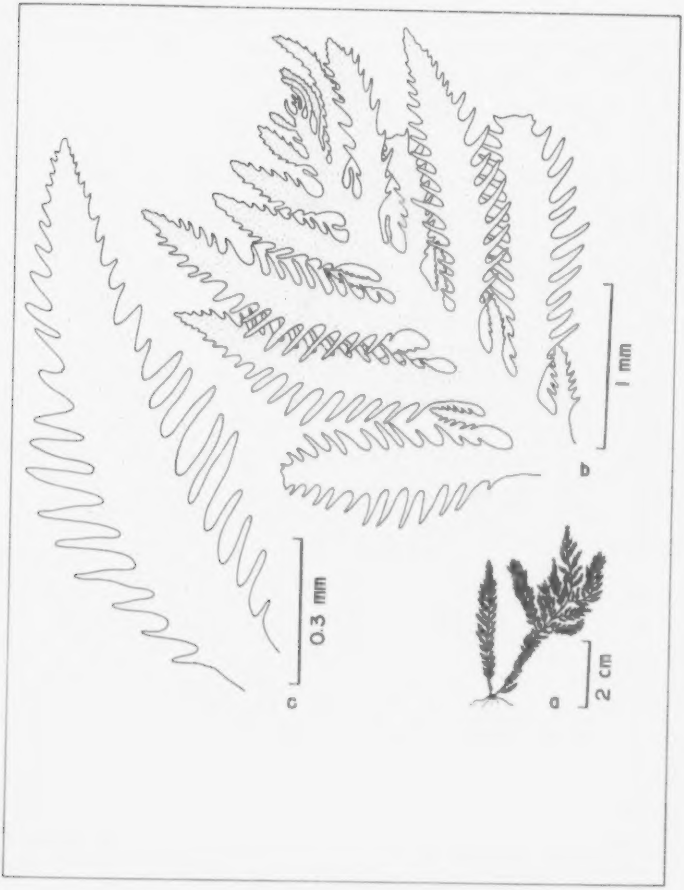

c
0.3 mm
b
1 mm
a
2 cm

Fig. 125. *Ptilota tenuis* Kylin. *a*, Habit of plant attached to substrate; *b*, *c*, enlarged views of portions of the plant showing branching habit.

MEMBRANOPTERA Stackhouse

Four species of the genus *Membranoptera* — *M. dimorpha* Gardner, *M. platyphylla* (Setchell and Gardner) Kylin, *M. tenuis* Kylin, and *M. weeksiæ* Setchell and Gardner — are recorded from British Columbia. One of these, *M. platyphylla,* is described and illustrated here.

Membranoptera platyphylla **(Setchell and Gardner) Kylin**

Descripiton.—The plant (Fig. 126*a*) is erect, up to 8 cm. high and 10 mm. wide, rose red in colour, branched, with a conspicuous percurrent midrib and microscopic lateral veins centrally traversing the branches from base to apex. The plant is irregularly dichotomously branched into narrow linear branches and is attached to the substrate by a small discoid holdfast. The branches are somewhat ruffled and smooth to minutely serrate along the margins. The portions of the plant lateral to the midrib are monostromatic. The midrib portion is more than one cell thick.

Habitat.—On piles and rocks in the lower intertidal and upper subtidal zones.

Pacific Coast Distribution. — Southern British Columbia to Oregon.

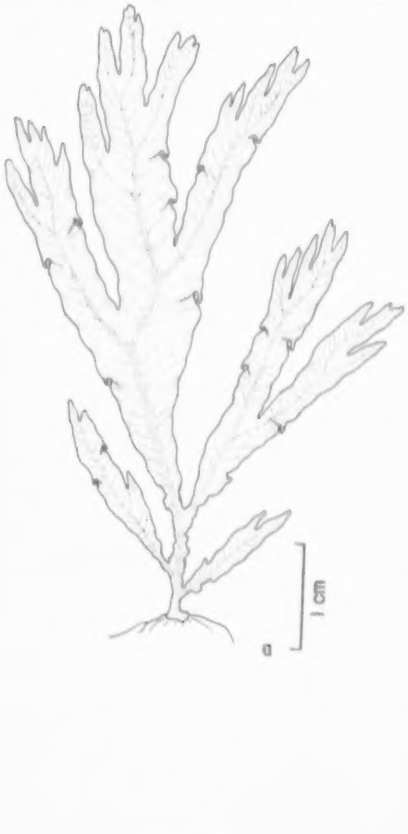


Fig. 126. *Membranoptera platyphylla* (Setchell and Gardner) Kylin. *a*, Habit of the plant, showing branching characteristics and conspicuous midrib and veins.

DELESSERIA Lamouroux

One species of the genus *Delesseria, D. decipiens* J. Agardh, which is described and illustrated here, is recorded from British Columbia.

Delesseria decipiens **J. Agardh**

Description.—The plant (Fig. 127*a*) is erect, up to 35 cm. tall and 12 mm. broad, rose red to purplish red in colour, with several orders of branching. The branches are regularly alternate, distichous, narrowly linear, and arise from a conspicuous percurrent midrib (Fig. 127*b*). The plant is attached to the substrate by a small discoid holdfast. The midrib region is several cells thick; the portion lateral to the midrib is monostromatic. Minute microscopic veins occur in the monostromatic region and lie diagonal to the midrib.

Habitat.—On rocks in the upper subtidal zone and to a depth of 5–10 fathoms.

Pacific Coast Distribution.—Attu Island, Alaska, to California.

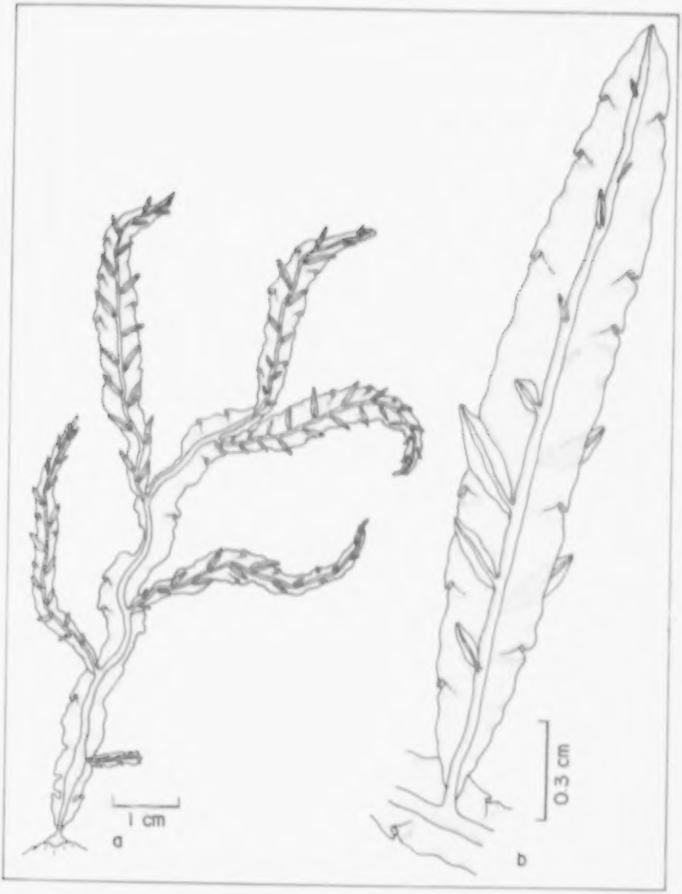


Fig. 127. *Delesseria decipiens* J. Agardh. *a*, Habit of plant attached to substrate; *b*, enlarged view showing branching characteristics.

POLYNEURA Kylin

Only one species of the genus *Polyneura, P. latissima* (Harvey) Kylin, which is described and illustrated here, is recorded from British Columbia.

***Polyneura latissima* (Harvey) Kylin**

Description.—The plant (Fig. 128*a*) is erect, up to 30 cm. tall, rose red in colour, often in clusters, attached to the substrate by a small discoid holdfast. The basal region has a narrow short cylindrical stipe which merges above into a broad, flat simple ovate blade. In older plants the blade is often deeply incised. The blade has a conspicuous system of anastomosing veins extending almost to the margin. Younger portions of the plant are monostromatic; older portions are several cells thick.

Habitat.—On stones, worm tubes, and wood in the lower intertidal and subtidal zones to a depth of 5–10 fathoms.

Pacific Coast Distribution.—Alaska to Mexico.

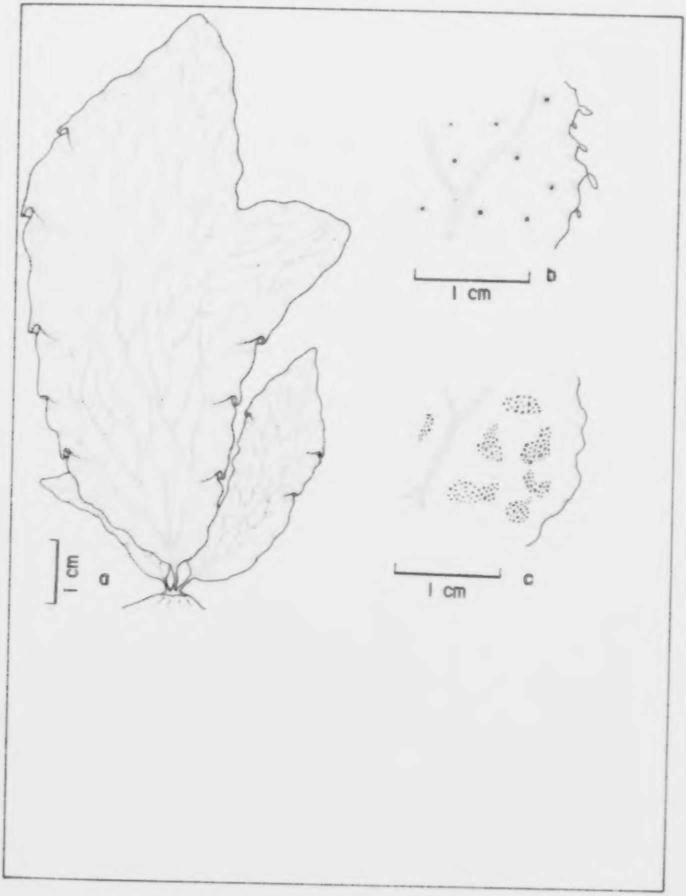


Fig. 128. *Polyneura latissima* (Harvey) Kylin. *a*, Habit of cluster of plants; *b*, enlarged view of a portion of a female plant showing cystocarps; *c*, enlarged view of a portion of the tetrasporangiate plant showing patches of tetrasporangia.

HYMENENA Greville

Two species of the genus *Hymenena* — *H. flabelligera* (J. Agardh) Kylin and *H. setchellii* Gardner, both of which are described and illustrated here — are recorded from British Columbia.

Hymenena flabelligera (J. Agardh) Kylin

Description.—The plant (Fig. 129*a*) is erect, up to 30 cm. tall, orange red to dull red in colour, profusely branched more or less dichotomously or palmately into linear segments, and attached to the substrate by a small discoid holdfast. In the basal part of the plant a conspicuous midrib is apparent, above merging into a system of delicate veins. The margins of the blade are usually smooth, and more than one cell in thickness; the midrib region is several cells thick.

Habitat.—On rocks in the upper subtidal zone.

Pacific Coast Distribution.—Alaska to California.

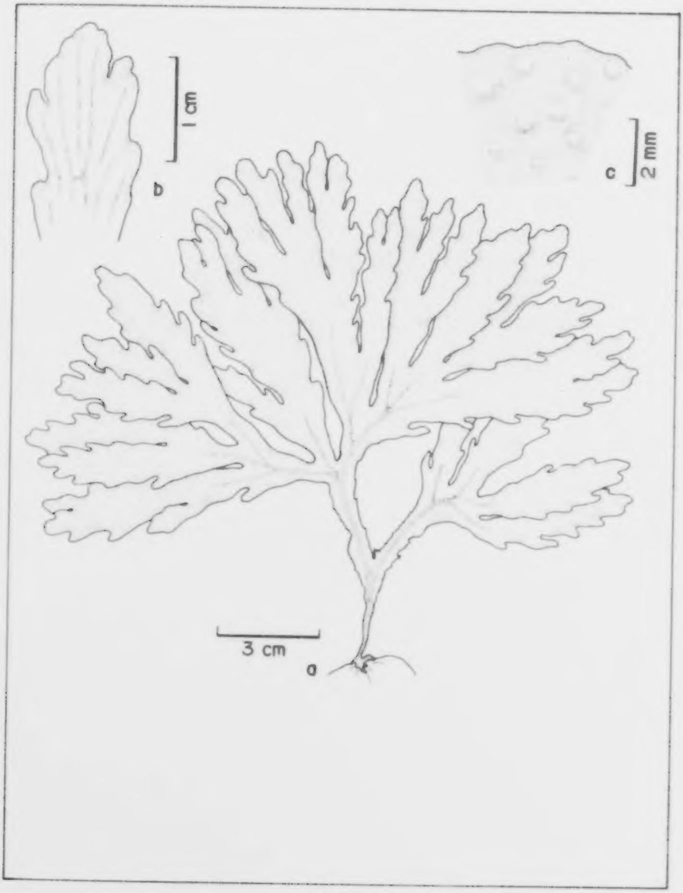


Fig. 129. *Hymenena flabelligera* (J. Agardh) Kylin. *a*, Habit of plant attached to substrate; *b*, enlarged view of a fertile portion of the plant showing tetrasporangiate regions in lines; *c*, enlarged view of a fertile portion of the plant showing swollen cystocarpic regions.

***Hymenena setchellii* Gardner**

Description.—The plant (Fig. 130*a*) is erect, up to 15 cm. tall, rose red in colour, branched more or less dichotomously or palmately into broad linear segments, and attached to the substrate by a small discoid holdfast. The margins of the branches are ruffled, and may be smooth or toothed. The basal part of the plant has a conspicuous midrib, which above merges gradually into a system of delicate veins. The margins of the blade are more than one cell in thickness; the midrib region is several cells thick.

Habitat.—On rocks in the subtidal zone to a depth of 5–10 fathoms.

Pacific Coast Distribution. — Northern British Columbia to California.

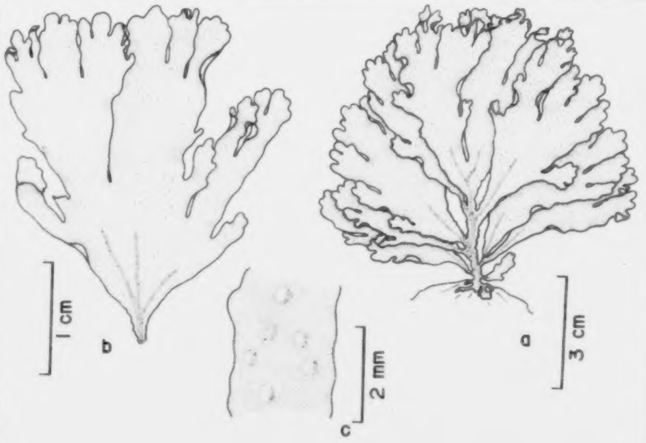


Fig. 130. *Hymenena setchellii* Gardner. *a*, Habit of plant attached to substrate; *b*, enlarged view of portion of plant showing branching characteristics; *c*, enlarged view of fertile portion of plant showing swollen cystocarpic regions.

CRYPTOPLEURA Kützing

Two species of the genus *Cryptopleura* — *C. ruprechtiana* (J. Agardh) Kylin and *C. violacea* (J. Agardh) Kylin — are recorded from British Columbia. One of these, *C. ruprechtiana*, is described and illustrated here.

Crytopleura ruprechtiana **(J. Agardh) Kylin**

Description.—The plant (Fig. 131*a*) is erect, up to 40 cm. tall, rose red to purplish red in colour, branched more or less dichotomously or palmately into broad linear segments, and attached to the substrate by a small discoid holdfast. The margins of the branches are ruffled, usually with a profusion of semicircular proliferous lobes along both margins. The basal part of the plant has a conspicuous midrib, which above merges gradually into a system of delicate veins. The margins of the blade are more than one cell in thickness; the midrib region is several cells thick.

Habitat.—On rocks in the lower intertidal and subtidal zones to a depth of 5–10 fathoms.

Pacific Coast Distribution.—Alaska to California.

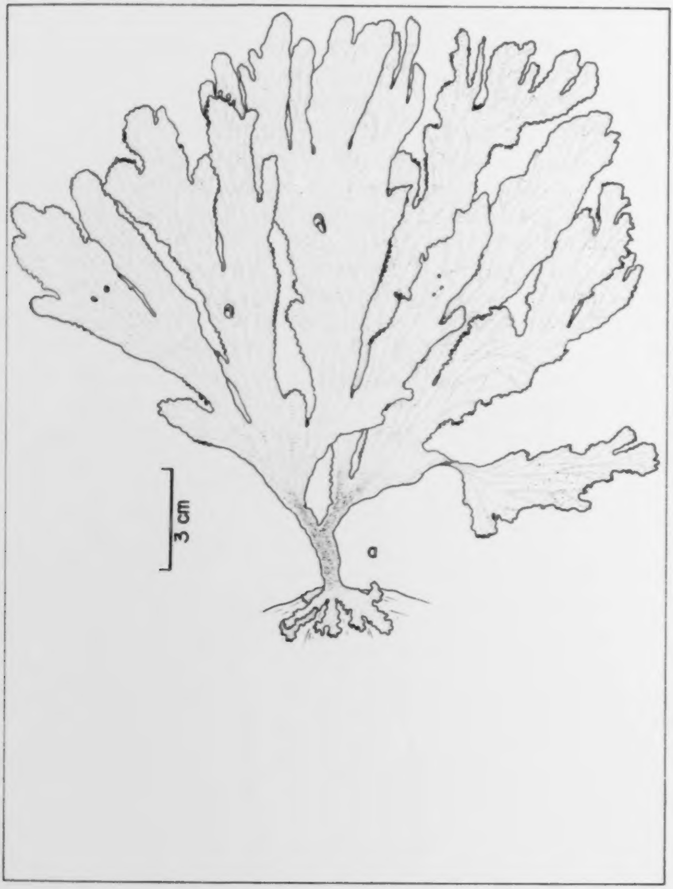


Fig. 131. *Cryptopleura ruprechtiana* (J. Agardh) Kylin. *a,* Habit of plant attached to substrate, showing branching habit.

RHODOPTILUM J. Agardh

Only one species of the genus *Rhodoptilum, R. plumosum* (Harvey and Bailey) Kylin, which is described and illustrated here, is recorded from British Columbia.

Rhodoptilum plumosum **(Harvey and Bailey) Kylin**

Description.—The plant (Fig. 132*a*) is erect, up to 30 cm. tall, bright red in colour, profusely branched and attached to the substrate by a small discoid holdfast. The main axis is percurrent, slightly compressed, up to 3 mm. broad. The branching is distichous, with several orders of branches, the ultimate orders (Fig. 132*c*) being uniseriate branched filaments, all approximately the same length in a dense fringe along both margins of the axis. Proximal regions of the plant are polysiphonous with dense cortication.

Habitat.—On wood and stones in the subtidal zone to a depth of 5–10 fathoms.

Pacific Coast Distribution. — Northern British Columbia to California.

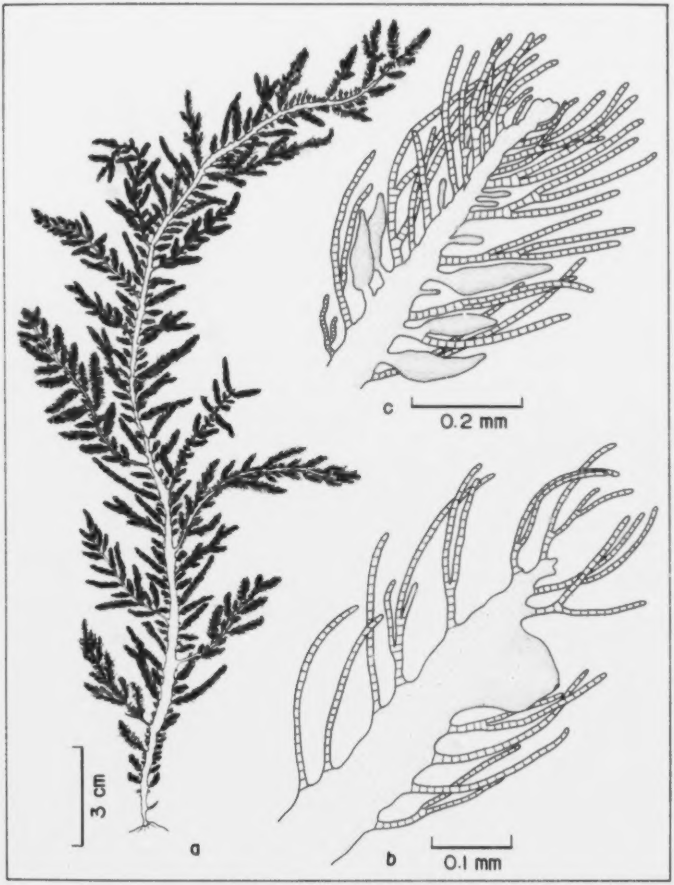


Fig. 132. *Rhodoptilum plumosum* (Harvey and Bailey) Kylin. *a*, Habit of a plant attached to the substrate; *b*, *c*, enlarged views of fertile regions of the plant showing cystocarpic (*b*) and tetrasporangial branches (*c*).

POLYSIPHONIA Greville

Seven species of *Polysiphonia* — *P. collinsii* Hollenberg, *P. macounii* Hollenberg, *P. pacifica* Hollenberg, *P. paniculata* Montagne, *P. senticulosa* Harvey, *P. snyderæ* Kylin, and *P. urceolata* (Dillwyn) Greville — are recorded from British Columbia. One of these, *P. collinsii*, is described and illustrated here.

Polysiphonia collinsii Hollenberg

Description.—The plant (Fig. 133*a*) is erect, up to 4 cm. high, in dense clusters, profusely branched, dark reddish brown in colour, attached to the substrate by rhizoidal filaments (Fig. 133*b*). The erect portion of the plant has a conspicuous main axis which branches irregularly but tending to be unilateral. The branches are cylindrical. The plant has cells arranged in regular tiers (Fig. 133*e*) or segments, each with a central axial cell surrounded by a number of pericentral cells. The number of pericentral cells per segment varies from 12 to 14. The axes are uncorticated. A uniseriate trichoblast (or scar cell) occurs on every second or third segment. The trichoblasts (Fig. 133*d*) are branched and evanescent, and are usually apparent only near the apex of the plant.

Habitat.—On rocks and epiphytic on coralline algæ in the middle intertidal zone.

Pacific Coast Distribution. — Northern British Columbia to Mexico.

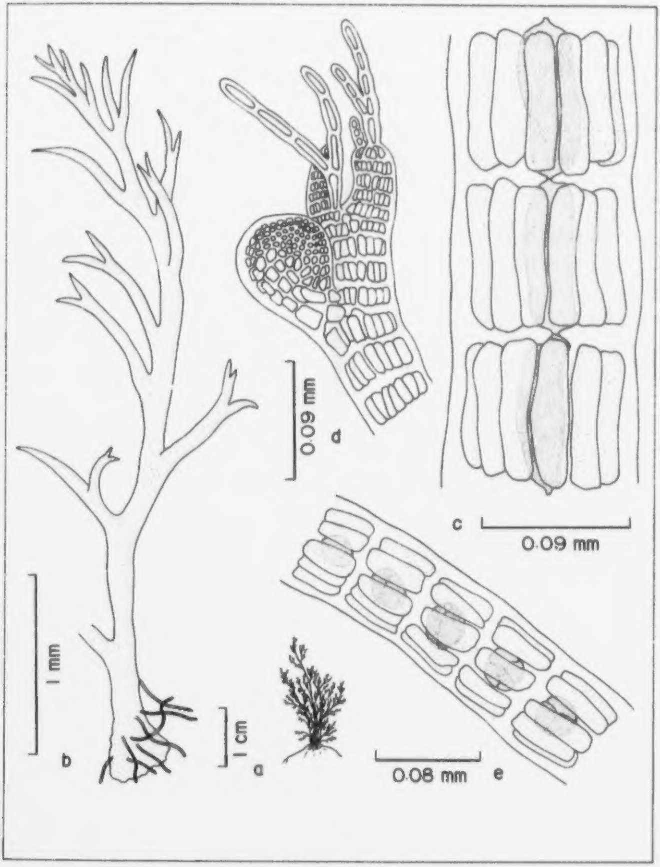


Fig. 133. *Polysiphonia collinsii* Hollenberg. *a*, Habit of cluster of plants attached to substrate; *b*, enlarged view of plant showing branching habit; *c*, enlarged view of vegetative portion of plant showing arrangement of cells; *d*, *e*, enlarged views of fertile regions of plant showing cystocarpic (*d*) and tetrasporangiate (*e*) regions.

PTEROSIPHONIA Falkenberg

Four species of the genus *Pterosiphonia* — *P. arctica* Setchell and Gardner, *P. bipinnata* (Postels and Ruprecht) Falkenberg, *P. dendroidea* (Montagne) Falkenberg, and *P. gracilis* Kylin — are recorded from British Columbia. Two of these, *P. bipinnata* and *P. dendroidea,* are described and illustrated here.

Pterosiphonia bipinnata (Postels and Ruprecht) Falkenberg

Description.—The plant is erect, up to 25 cm. high, in dense clusters, profusely branched, with branches cylindrical, densely matted and intertwined into rope-like strands (Fig. 134*a*), dark brownish red in colour. The plant is attached to the substrate by rhizoidal filaments. Branching is irregular and obscured below, but is alternate and distichous (Fig. 134*b*) in the final orders. The branches have a central axial row of cells surrounded by 11–13 pericentral cells. The branches are uncorticated. The cells occur in tiers (Fig. 134*c*). Trichoblasts and scar cells are absent.

Habitat.—On rocks and epiphytic on other algæ in the intertidal and upper subtidal zones.

Pacific Coast Distribution.—Alaska to California.

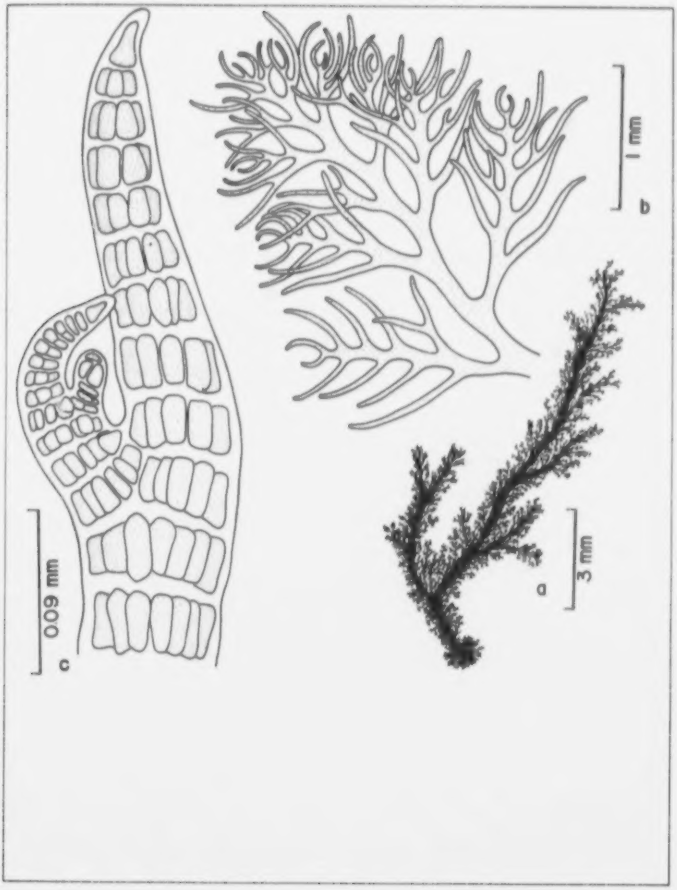


Fig. 134. *Pterosiphonia bipinnata* (Postels and Ruprecht) Falkenberg. *a*, Habit of plant; *b*, enlarged view of portion of plant showing branching habit; *c*, enlarged view of a vegetative portion of the plant showing arrangement of cells.

Pterosiphonia dendroidea (**Montagne**) **Falkenberg**

Description.—The plant (Fig. 135*a*) is erect, up to 10 cm. high, reddish brown in colour, attached to the substrate by rhizoidal filaments. The erect portion of the plant has a conspicuous percurrent axis pinnately branched with branches distichous. The lateral branches from the percurrent axes are all approximately the same length. The axes and branches are markedly compressed. Cells in the branches are arranged in regular tiers (Fig. 135*d*), with each segment having a central cell surrounded by 8–12 pericentral cells and remaining uncorticated. Trichoblasts and scar cells are lacking.

Habitat.—On rocks and epiphytic on other algæ in the lower intertidal and subtidal zones to a depth of 5–10 fathoms.

Pacific Coast Distribution.—Alaska to Mexico.

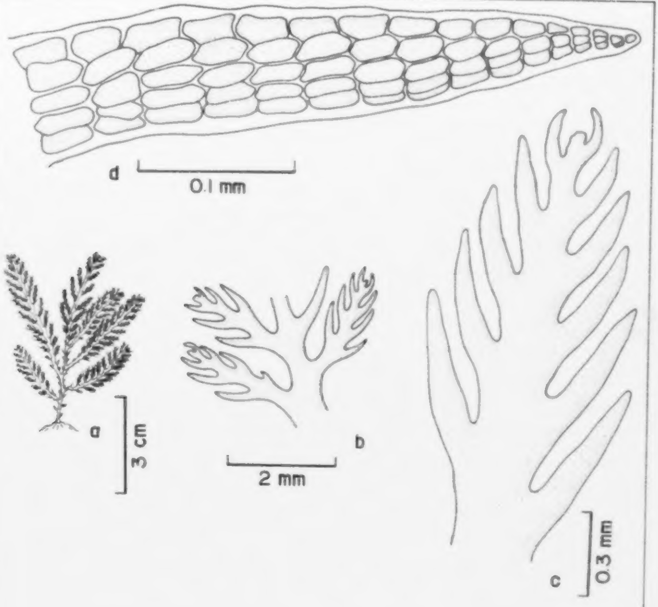


Fig. 135. *Pterosiphonia dendroidea* (Montagne) Falkenberg. *a*, Habit of plant attached to substrate; *b*, *c*, enlarged views of portion of the plant showing branching habit; *d*, enlarged surface view of portion of plant showing arrangement of cells.

LAURENCIA Lamouroux

Only one species of the genus *Laurencia, L. spectabilis* Postels and Ruprecht, which is described and illustrated here, is recorded from British Columbia.

Laurencia spectabilis Postels and Ruprecht

Description.—The plant (Fig. 136*b*) is erect, up to 20 cm. tall, in dense clusters (Fig. 136*a*), purplish red in colour, of firm cartilaginous consistency, branched with branches markedly compressed, attached to the substrate by a small discoid holdfast. The erect portion of the plant is pinnately divided, with branches more or less opposite. The ultimate branches (Fig. 136*c*) are blunt with a slight indentation at the apex. Evanescent trichoblasts are apparent in the indentation. Although polysiphonous in structure, the tiered arrangement of cells in segments is only apparent near the apex. In more mature regions the medulla is made up of large colourless cells with an inconspicuous axial row of cells; the medulla is of small cells, becoming progressively smaller toward the surface.

Habitat.—On rocks in the lower intertidal and upper subtidal zones.

Pacific Coast Distribution.—Alaska to California.

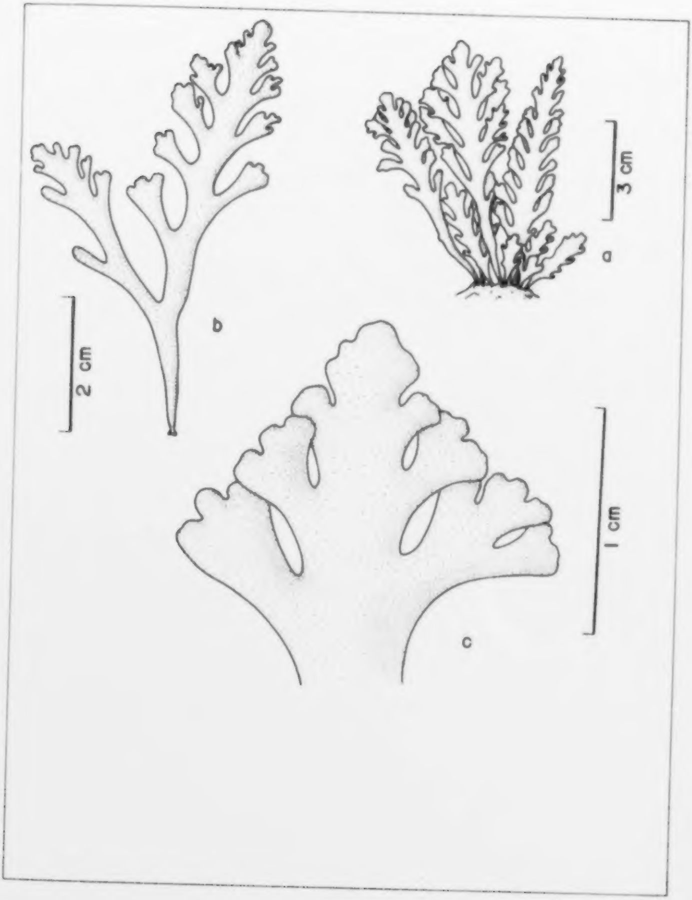


Fig. 136. *Laurencia spectabilis* Postels and Ruprecht. *a*, Habit of cluster of plants attached to substrate; *b*, habit of single plant showing branching habit; *c*, enlarged view of portion of plant showing branching characteristics.

RHODOMELA C. Agardh

Two species of the genus *Rhodomela, R. larix* (Turner) C. Agardh and *R. lycopodioides* (L.) C. Agardh, are recorded from British Columbia. Only one of these, *R. larix,* is described and illustrated here.

Rhodomela larix (Turner) C. Agardh

Description.—The plant (Fig. 137*a, b*) is erect, up to 30 cm. high, brownish black in colour, in clusters, attached to the substrate by a discoid holdfast. The plant is branched, usually with one or more major cylindrical axes. The major axes have a profusion of radially arranged cylindrical branchlets, all approximately the same length and unbranched. At the apices of the branches, evanescent trichoblasts are apparent. Although having a polysiphonous organization, the tiered arrangement of cells is apparent only near the apex. In more mature regions, as a result of cortication, the axis appears in sectional view (Fig. 137*c*) to have a medulla of large cells (with a conspicuous axial row of cells) and a cortex of small cells becoming progressively smaller toward the surface.

Habitat.—On rocks in the intertidal zone.

Pacific Coast Distribution.—Bering Sea to California.

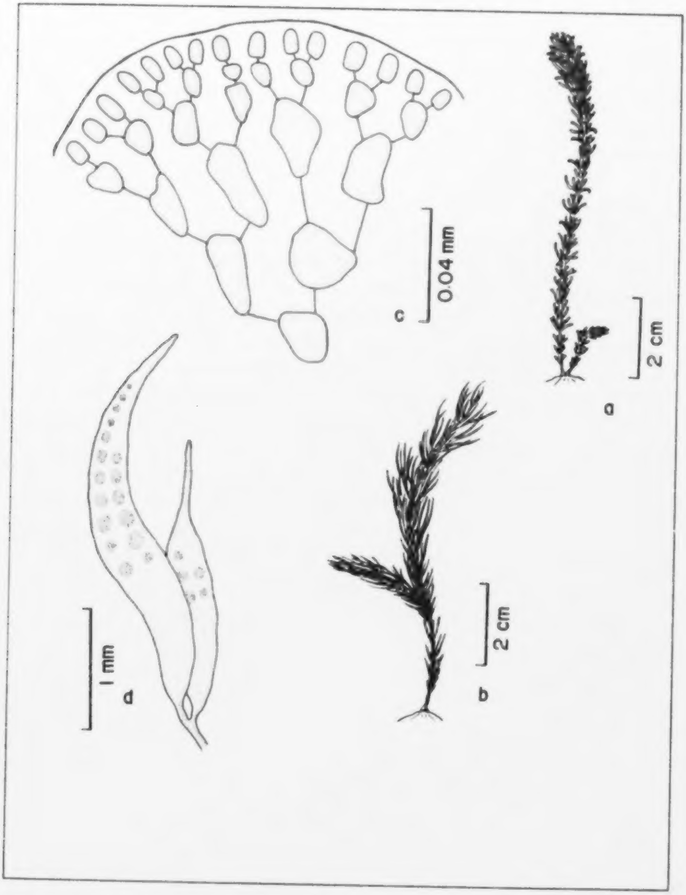


Fig. 137. *Rhodomela larix* (Turner) C. Agardh. *a*, Habit of cystocarpic plant; *b*, habit of tetrasporangiate plant; *c*, transverse section of a portion of the plant showing arrangement of cells; *d*, enlarged surface view of tetrasporangial branch showing rows of tetrasporangia.

ODONTHALIA Lyngbye

Four species of the genus *Odonthalia* — *O. floccosa* (Esper) Falkenberg, *O. kamtschatica* (Ruprecht) J. Agardh, *O. lyallii* (Harvey) J. Agardh, and *O. washingtoniensis* Kylin—are recorded from British Columbia. One of these, *O. floccosa,* is described and illustrated here.

Odonthalia floccosa **(Esper) Falkenberg**

Description.—The plant (Fig. 138*a*) is erect, up to 40 cm. tall, profusely branched, brownish black in colour, slightly compressed, and attached to the substrate by a small discoid holdfast. The plant branches with a few main axes that may be almost cylindrical near the base, and several orders of progressively smaller branches that are compressed, distichous, and alternately arranged. The ultimate branchlets (Fig. 138*b*) are gradually attenuated to an acute apex. Although having a polysiphonous organization, the tiered arrangement of cells is apparent only near the apex. In more mature regions, as a result of extensive cortication, the axis appears in section to have a medulla of large cells (with an inconspicuous central row of cells) and a cortex of densely packed small cells that become progressively smaller toward the surface.

Habitat.—On rocks in the intertidal zone.

Pacific Coast Distribution.—Alaska to California.

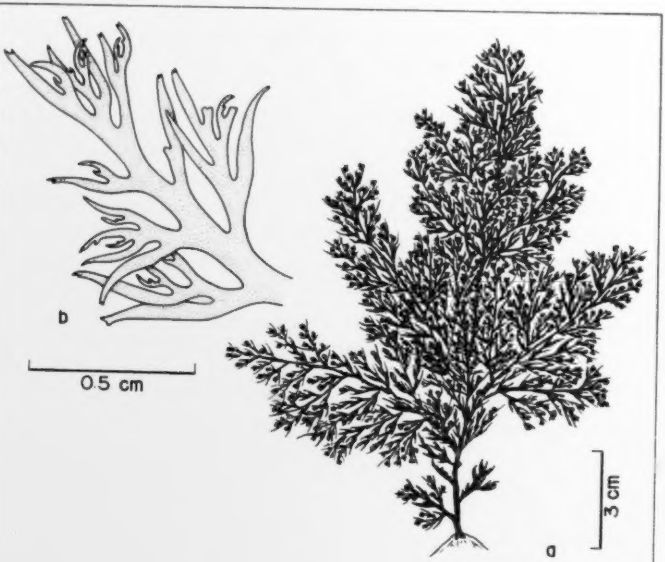


Fig. 138. *Odonthalia floccosa* (Esper) Falkenberg. *a*, Habit of plant fastened to substrate; *b*, enlarged view of portion of plant showing branching characteristics.

MARINE SEED PLANTS (SEA GRASSES)

Although there are eight genera and numerous species of marine seed plants known throughout the world, only two genera are represented on the coast of British Columbia. One of these, *Zostera,* has two forms or varieties; the other, *Phyllospadix,* has two species represented in this area. Both have superficial grass-like characteristics, but they are not closely related to the true grasses. They are rooted aquatic plants and are thought to have originated in fresh water, where their nearest relatives, the pondweeds, occur. The flowers are inconspicuous and are pollinated under water by the aid of water currents. Both genera are perennial and have rhizomes, or prostrate stem-like shoots, which grow longer and produce new sets of roots and leaves each year. A key to the genera of marine seed plants included in this guide appears below.

KEY TO GENERA OF MARINE SEED PLANTS

PAGE

1. Leaves flat, more than 32 mm. wide; plants generally occurring in protected bays, with rhizomes and roots embedded in mud; dull green in colour—ZOSTERA 313

1. Leaves flat to oval or circular in cross-section, less than 32 mm. wide; plants attached to rough rock or with rhizomes and roots in rock crevices on exposed coasts; usually bright green to emerald green in colour—PHYLLOSPADIX 316

ZOSTERA L.

Only one species, *Zostera marina* L., with two varieties of this genus (commonly known as eelgrass) occurs in British Columbia. *Zostera marina* extends all along the Pacific Coast of North America from San Diego to Alaska and is similar to the eelgrass of the North Atlantic. The plants usually occur in quiet water of protected bays, with the roots and creeping rhizomes embedded in mud or sand. They are pale, dull green in colour. At times they form dense and extensive subtidal beds from 2 to 3 feet above down to about 20 feet below low-tide level. The two distinct forms occupy quite distinct zones; both of these forms are described, and one of them, *Zostera marina* var. *marina*, is illustrated here.

***Zostera marina* L.**

KEY TO FORMS

PAGE

1. Leaves broad, about 60 mm. in width, with 3–7 veins, and up to 4 feet long—*Z. marina* var. *marina* 314

1. Leaves broad, from 60 to 125 mm. in width, 3–7 veins, and up to 13 feet long—*Z marina* var. *latifolia* 314

Zostera marina L. var. marina

Description.—This narrow-leafed variety is found in shallow water, from 2 feet above to 3 feet below extreme low-tide level. The leaves are usually about 60 mm. wide, have 3–7 longitudinal veins, and may be up to 4 feet long. The roots and creeping rhizomes are embedded in the mud.

Habitat.—In quiet bays, usually with mud bottom, in the lower intertidal and upper subtidal regions.

Pacific Coast Distribution.—Alaska to Mexico.

Zostera marina L. var. latifolia Morong

Description.—This broad-leafed variety is a deeper-water plant generally, and is larger in all respects. The leaves reach lengths of 10–13 feet, are 60–125 mm. wide, and have 3–7 veins. The plants grow from about low-tide level down to about 20 feet deep on a muddy bottom. The roots and creeping rhizomes are embedded in the mud.

Habitat.—In quiet bays, usually with mud bottom, in the upper subtidal zone.

Pacific Coast Distribution.—Alaska to Mexico.

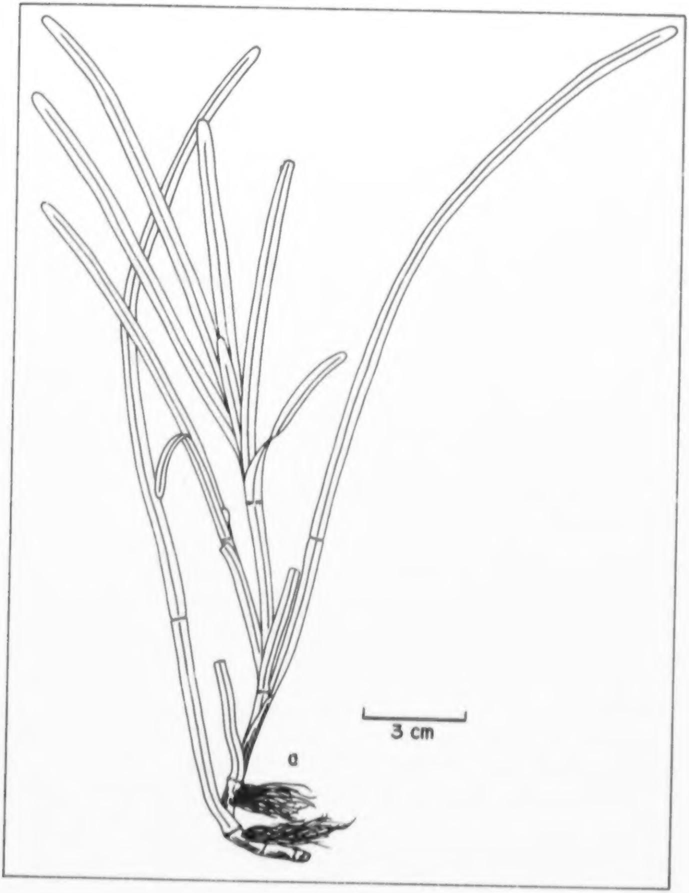


Fig. 139. *Zostera marina* L. var. *marina*. *a*, Habit of the plant.

PHYLLOSPADIX Hooker

There are two species of this genus, commonly known as basket grass, in British Columbia. The genus *Phyllospadix* is confined to the North Pacific Ocean. One species is recorded in Japan and two on the west coast of North America. Although *Phyllospadix* possesses many of the grass-like characteristics of *Zostera,* this genus differs markedly in its habitat. *Phyllospadix* occurs characteristically on rocky wave-swept shores and is attached to rough rocks or wedged in crevices by means of its creeping rhizomes and roots. In contrast to *Zostera,* which is generally a pale dull-green colour, *Phyllospadix* is a bright emerald green. Both species are described and illustrated here.

KEY TO SPECIES OF PHYLLOSPADIX

	PAGE
1. Plants short, usually less than 3 feet in length, with flat leaves, 20–32 mm. in width; with short basal flowering stalks 5–8 cm. long—*P. scouleri*	316
1. Plants tall, usually up to 10 feet in length, with wiry leaves, oval or circular in cross-section and less than 20 mm. in width; with long basal flowering stems up to 30 cm. long—*P. torreyi*	318

Phyllospadix scouleri **Hooker**

Description.—*Phyllospadix scouleri* is most characteristic of the open rocky shores of the coast which are exposed to the full force of the waves, as on the west coast of Vancouver Island. There it forms bright emerald-green beds on the rocks near extreme low-tide level. The plants are relatively short, usually not more than 3 feet in length, and the leaves are 20–32 mm. wide. Short basal flowering stems are produced, which are 5–8 cm. long.

Habitat.—On rocks in the lower intertidal and upper subtidal zones.

Pacific Coast Distribution.—Alaska to Mexico.

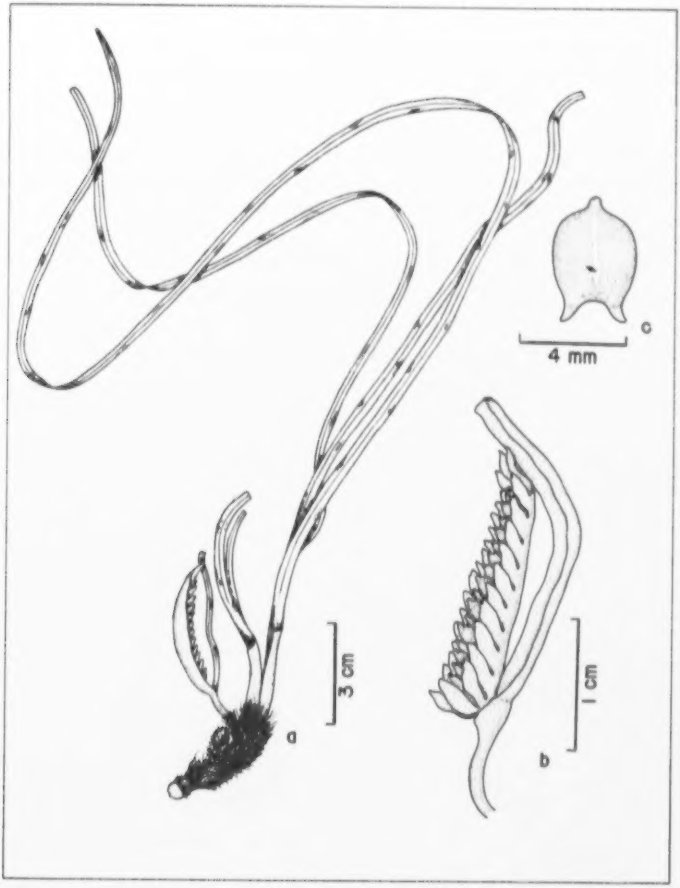


Fig. 140. *Phyllospadix scouleri* Hooker. *a*, Habit of plant; *b*, enlarged view of special branchlet bearing seeds; *c*, enlarged view of a single seed.

Phyllospadix torreyi Watson

Description.—*Phyllospadix torreyi* is also found on the open rocky coast, but in contrast to *P. scouleri,* it is usually in deeper water or in deep rocky pools protected from the full force of the waves. It is a larger plant than *P. scouleri* and reaches a length of nearly 10 feet. When mature, the leaves are wiry and less than 20 mm. wide. Mature leaves tend to be more oval or circular in cross-section than the flattened leaves of *Zostera* and *P. scouleri.* Long basal flowering stems are produced, which are about 12 inches in length.

Habitat.—On rocks in the subtidal zone.

Pacific Coast Distribution.—Alaska to Mexico.

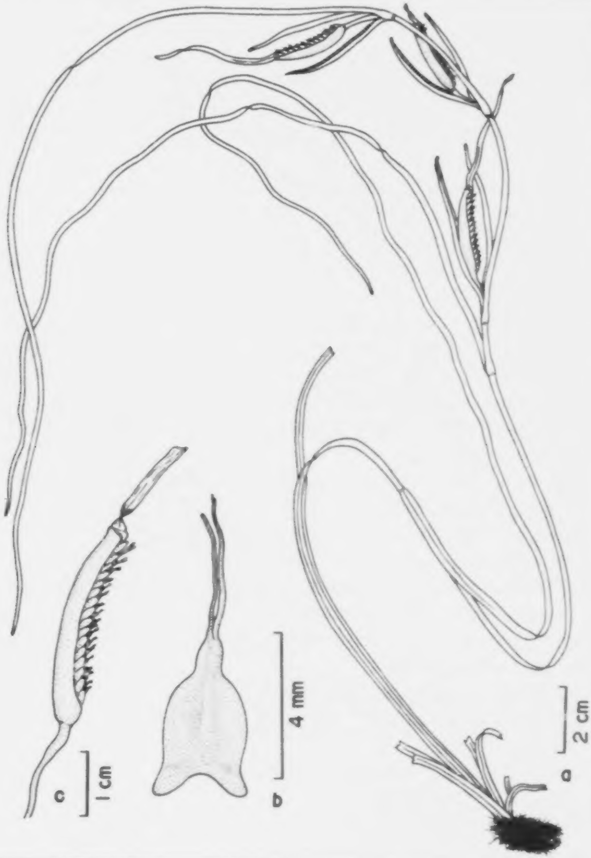


Fig. 141. *Phyllospadix torreyi* Watson. *a*, Habit of plant; *b*, enlarged view of seed; *c*, enlarged view of special branchlet bearing seeds.

GLOSSARY

Acute—tapering to a sharp point.

Adjoined—lying in contact with.

Algal—with reference to an alga.

Alternate—not opposite or arranged only along one side.

Alternation of generations—usually the alternation of a haploid sexual gamete-producing phase with a diploid spore-producing phase.

Anastomosing—communicating by cross-connections.

Anatomical—with reference to the internal structure.

Angular—with divergent sides.

Antheridium (pl. *antheridia*) — gametangium-producing male gamete(s).

Apex (pl. *apices*)—the distal end.

Apical—at or referring to the apex.

Apical cell—a cell situated at the apex of a plant or its branches and specialized for initiating growth.

Apiculate—terminating in a sharp or spiny point.

Articulated—jointed.

Assimilating filament—a superficial filament the cells of which contain chloroplasts.

Attenuated—long and drawn out.

Axial—with reference to an axis.

Axial filament—a longitudinal series of cells running through the centre of an axis or branch.

Axis (pl. *axes*)—the longitudinal portion on which the parts of a plant are arranged.

Biflagellate—possessing two flagella.

Bifurcate—divided into two branches; forked.

Biseriate—in two rows.

Blade—a flattened leaf-like part of a plant.

Bladelet—a small blade.

Branchlet—a small branch.

Bullate—having a blistered appearance.

Bullation—a blister.

Calcareous—stony and containing lime.

Calcified—encrusted with lime.

Carpogonium—female gametangium in red algæ.

Carpospore—a spore produced in a carposporangium.

Cartilaginous—hard, tough, and elastic.

Catenate—arranged end to end like a string of beads.

Cellular—with reference to a cell or cells.

Central cell—a cell of the axial filament (particulary in polysiphonous red algæ).

Chlorophyll—the green colouring matter of plants.

Complanate—flattened or compressed and smooth.

Compressed—flattened.

Concentric—having a common centre.

Conceptacle—a fertile cavity opening to the surface of a plant.

Confluent—blended or merging into one.

Conical—in the shape of a cone.

Contorted—twisted.

Convoluted—when one part is rolled up into another.

Coralline—referring to lime-encrusted red algæ.

Cordate—heart-shaped, with the point directed upward.

Cortex—the portion of the plant external to the medulla or an axial filament.

Cortical—with reference to the cortex.

Corticated—having a cortex.

Cortication—a region with a cortex.

Crisped—curled up.

Cubical—having the shape of a cube.

Cuneate—wedge-shaped.

Cystocarp—the mature structure in red algæ comprising a gonimoblast and surrounding pericarp.

Cystocarpic—with reference to a cystocarp.

Demarcated—set apart or distinguishable.

Dentate—toothed.

Denticulate—minutely toothed.

Dichotomy (pl. *dichotomies*)—a forking into two similar parts.

Dichotomous—with branching by repeated forking.

Diploid—having a single set of paried chromosomes (twice the number of chromosomes as in gametes) (2N).

Discoid—in the form of a disk.

Dissected—divided into a number of parts.

Dissimilar—not the same, unlike.

Distal—remote from the point of attachment.

Distichous—in two rows or ranks.

Distromatic—two cells in thickness.

Ecological—with reference to ecology.

Ecology—the study of plant life in relation to environmental factors.

Egg—a non-motile female gamete.

Ellipsoid—in the form of an ellipse.

Ellipsoidal—with reference to an ellipsoid.

Elliptical—with reference to an ellipsoid.

Emergent—arising above, as a raised outgrowth.

Encrusting—covering with a layer or crust.

Epiphyte—a plant growing superficially on the surface of another plant.

Epiphytic—occurring as an epiphyte.

Equidimensional—with dimensions equal along all planes.

Evanescent—of short duration.

Falcate—sickle-shaped.

Fasiculate—in a small cluster or tuft.

Fertile—with reproductive structures.

Fertilized—condition when one gamete fuses with another to form a zygote.

Filament—a branched or unbranched row of cells joined usually in a single series.

Filamentous—in the form of a filament.

Filiform—hair-like.

Flabellate—fan-shaped.

Flaccid—soft and flabby.

Flagellum (pl. *flagella*)—the hair-like organ by which a motile cell swims in the water.

Flexuous—winding.

Float—air-filled structure.

Floristic—with reference to a flora or the assemblage of plants and their geographic distribution in a specific area.

Forcipate—forked and incurved like crab claws.

Gametangial—with reference to a gametangium.

Gametangium (pl. *gametangia*)—a sex organ in which a gamete or gametes are formed.

Gamete—a sex cell.

Gametophyte—gamete-producing plant (generally haploid).

Gametophytic—with reference to the gametophyte.

Gelatinous—jelly-like.

Genus (pl. *genera*)—the smallest natural or related grouping of plants containing distinct species.

Gland cells—a large, colourless, usually refractive cell.

Globose—approximately spherical.

Gonimoblast—the carposporophyte, a phase developing from a zygote and producing carpospores.

Gregarious—occurring in close association with other individuals.

Habitat—the kind of locality in which a plant grows.

Hair—a narrow filament arising from the surface of a plant.

Haploid—having a single set of unpaired chromosomes (the chromosome complement present in the gametes) (1N).

Hapteron (pl. *haptera*)—the root-like portion of a holdfast (usually cylindrical and much branched).

Holdfast—a structure by which an alga is fastened to the substrate.

Horny—corneous in texture.

Incised—cut sharply from the margin.

Intercalary—occurring anywhere in a filament but not terminal nor basal in position.

Intercellular—between the cells or tissues.

Interlacing—intertwined.

Intersegmental—between the segments.

Intertidal—the zone between high- and low-tide levels.

Iridescent—having a shimmering of rainbow colours.

Joint—an articulaton.

Lacerated—torn.

Laciniate—cut into narrow lobes.

Lamina (pl. *laminæ*)—blade-like plant or part of a plant.

Lanceolate—narrow and tapering toward each end.

Lateral—situated at the side; a part of a plant arising from the side.

Leaflet—a small leaf-like branch.

Life history—the course of development from any given stage to the same stage again, as from zygote to zygote.

Ligulate—strap-like.

Linear—narrow, several times longer than broad.

Lobed—a rounded division of a plant.

Marginal—at the margin.

Median—at the middle.

Medulla—the central core of tissue of a multicellular alga.

Medullary—with reference to the medulla.

Meiosis—reduction division in which the number of chromosomes is reduced from the diploid (2N) to the haploid (1N) state.

Membranous—like a membrane, or thin pliable layer.

Midrib—a thickened longitudinal axis of a flattened plant.

Mitosis—division in which the number of chromosomes is not reduced.

Mitotic—with reference to mitosis.

Mitotically—by means of mitotic division.

Monographic—with reference to a monograph (a systematic account of a particular group of plants).

Monosiphonous—consisting of a single series of cells.

Monospore—an asexual spore formed singly in a monosporangium.

Monostromatic—having a single layer of cells.

Morphology—form of plant.

Multicellular—having more than one (and usually many) cells.

Multiseriate—with several rows of cells.

Non-septate—without septæ (cross-walls or partitions generally perpendicular to the length of a filament).

Obovate—oval or egg-shaped with the broader end at the distal end.

Oogonium (pl. *oogonia*)—a female reproductive cell containing one to several eggs.

Opposite—arising at the same plane.

Ovoid—shaped like an egg.

Palmate—divided in a fan-like fashion so that the parts arise from a common point.

Palmately—in a palmate fashion.

Papilla (pl. *papillæ*)—a small emergent, nipple-like structure.

Papillate—having papillæ.

Paraphysis (pl. *paraphyses*)—sterile unicellular or multicellular hair associated with sporangia or gametangia.

Parasitic—growing on and obtaining food from another organism, the host.

Parenchyma—a group of thin-walled non-elongated randomly arranged cells.

Parenchymatous—made up of parenchyma.

Parietal—borne on or near the side walls.

Pectinate—with branches restricted to one side of the axis and set close together like the teeth of a comb.

Pectination—a tooth-like branch forming part of a pectinate branch system.

Percurrent—running through the entire length.

Pericarp—the sterile layer or layers of cells surrounding a carposporophyte (gonimoblast).

Pericentral—surrounding a central monosiphonous axis or cell.

Perfoliate—with the stem-like portion extending through the centre of the blade.

Perforate—full of holes.

Perforated—full of holes.

Perforations—holes of fairly regular form.

Phloem—food-conducting tissue of vascular plants.

Photosynthesis—the process by which green plants utilize light energy to manufacture organic food.

Photosynthetic—with reference to photosynthesis.

Phycologist—a specialist who studies algæ.

Phytoplankton—free-floating, or weakly swimming, aquatic plant life.

Pinnate—with branches on each side of a common axis; feather-like.

Pinnately—in a pinnate fashion.

Pit-connection—a protoplasmic connection between cells, with particular reference to certain red algæ.

Plurilocular—containing more than one chamber.

Pollinated—with reference to pollination (the process in plants by which pollen from a male plant or part of a plant is transferred to a female plant or part of a plant).

Polysiphonous—composed of more than one filament and having tiers of parallel vertically elongated cells.

Polystromatic—made up of several cell layers.

Proliferous—producing outgrowths, sometimes similar to the original.

Prostrate—lying along the substrate.

Protoplasmic continuity — having pit-connections or strands of protoplasm connecting adjacent cells.

Proximal—at the point of attachment.

Pyriform—pear-shaped.

Quadrately—with reference to a division or arrangement of parts into four segments at right angles.

Quadriflagellate—having four flagella.

Rachis—the portion of the axis of a plant from which subordinate parts of limited growth arise in two opposite ranks.

Radial—radiating from a common centre.

Receptacle—a differentiated, usually swollen region of an alga bearing conceptacles.

Recurved—curved back.

Reniform—kidney-shaped.

Repeatedly—in successive orders.

Reproductive—bearing reproductive structures (gametes or spores).

Reticulate—in the form of a net.

Reticulum—a network.

Rhizoid—a filamentous attachment organ.

Rhizoidal—in the form of a rhizoid.

Phizome—a prostrate stem-like portion.

Rib—a thickened ridge-like reinforcement in a flattened plant.

Ruffled—with a strongly waved margin.

Saccate—sac-like.

Saprophytic—a plant which derives its chemical energy from dead organic materials (not photosynthetic).

Scar cell—basal remnant of a trichoblast (appearing as a small cell).

Secund—with parts arising along one side only.

Segment—a joint or one of the portions into which a plant is divided.
Septate—having septæ (cross-walls or partitions generally perpendicular to the length of a filament).
Serrate—with minute teeth.
Sessile—without a stalk.
Simple—unbranched or undivided.
Sorus (pl. *sori*)—a group or cluster of reproductive organs.
Spatulate—oblong with one end attenuated like a spatula or spoon.
Species—a basic unit of classification (related species are grouped in a genus, which is the next higher unit of classification).
Sperm—a motile male reproductive cell.
Spermatangium (pl. *spermatangia*)—the male reproductive organ of red algæ.
Spermatium (pl. *spermatia*)—the non-motile male gamete of red algæ.
Sporangium (pl. *sporangia*)—a spore-producing reproductive organ.
Spore—a motile or non-motile reproductive cell which germinates and grows into a new plant.
Sporophyll—a specialized blade bearing sporangia.
Sporophyte—spore-producing plant (generally diploid).
Sporophytic—with reference to a sporophyte.
Stellate—star-shaped.
Sterile—without fertile (reproductive) structures.
Stipe—an erect stem-like portion of an alga.
Stipitate—having a stipe.
Subacute—somewhat acute.
Subdichotomously—sometwhat dichotomous but not rigidly so.
Substrate—the surface to which an alga is attached.
Subtidal—below the lowest low-tide level.
Syngamy—fusion of gametes (fertilization).
Taxonomic—with reference to taxonomy or classification.
Terete—cylindrical, tapering and rounded in sectional view.
Tertiary—of a third order.
Tetrasporangiate—bearing tetrasporangia.
Tetraspore—a non-motile spore produced in the tetrasporangium of a red alga.

Tissue—a group of cells similar in shape and function.

Traversing—crossing or stretching across.

Trichoblast—a simple or branched, usually colourless uniseriate filament.

Trichogyne—a receptive hair-like extension of the female gametangium in a red alga.

Tubercle—a warty outgrowth.

Tuberculate—with irregular warty outgrowths.

Tufted—in small bunches.

Ultimate—the final order.

Uncorticated—lacking a cortex.

Undulate—wavy.

Uniaxial—having only one axial longitudinal filament running down the centre of the alga.

Unilateral—occurring on one side only.

Uniseriate—occurring in one row or series.

Vascular—with reference to the conducting tissue of plants (chiefly xylem and phloem).

Vegetative—non-reproductive.

Vein—a smaller branch from a midrib or slightly thickened narrow region within a blade.

Verticil—a whorl of branches.

Verticillate—having verticils.

Vesicle—an air bladder or float.

Whorl—a group of branches radially distributed about and attached at the same plane of an axis.

Xylem—water-conducting tissue of vascular plants.

Zonate—divided by lines parallel to the surface.

Zoospore—a spore which is motile by means of one or more flagella.

Zygote—product of syngamy (diploid cell resulting from fusion of two haploid gametes).

SYSTEMATIC INDEX

PAGE

- *Agardhiella tenera* 226
- *Agarum cribrosum* 132
  - *fimbriatum* 134
- *Ahnfeltia concinna* 234
  - *plicata* 236
- *Alaria marginata* 150
  - *nana* 152
- *Antithamnion pacificum* 268
- *Bangia fuscopurpurea* 172
- *Bonnemaisonia nootkana* 182
- *Bossiella californica* 196
  - *plumosa* 198
- *Botryocladia pseudodichotoma* 258
- *Bryopsis corticulans* 72
- *Calliarthron regenerans* 202
  - *schmittii* 204
- *Callithamnion pikeanum* 270
- *Callophyllis edentata* 218
  - *flabellulata* 220
- *Ceramium californicum* 272
  - *pacificum* 274
- *Cladophora flexuosa* 60
  - *trichotoma* 62
- *Codium fragile* 68
  - *setchellii* 70
- *Coilodesme bulligera* 114
  - *californica* 116
- *Colpomenia sinuosa* 112
- *Constantinea simplex* 192
  - *subulifera* 194
- *Corallina vancouveriensis* 200
- *Costaria costata* 130
- *Cryptopleura ruprechtiana* 296
- *Cryptosiphonia woodii* 188
- *Cumagloia andersonii* 180
- *Cymathere triplicata* 128
- *Cystoseira geminata* 162
- *Delesseria decipiens* 288
- *Desmarestia foliacea* 92
  - *herbacea* 94
  - *intermedia* 96
  - *ligulata* 98
  - *munda* 100
- *Dictyoneurum californicum* 128
- *Dilsea californica* 190
- *Ectocarpus dimorphus* 80
- *Egregia menziesii* 156
- *Eisenia arborea* 154
- *Endocladia muricata* 208
- *Enteromorpha intestinalis* 44
  - *linza* 46
- *Erythrophyllum delesserioides* 222
- *Fucus gardneri* 158
- *Gastroclonium coulteri* 266

PAGE

- *Gelidium robustum* 184
  - *sinicola* 186
- *Gigartina cristata* 244
  - *exasperata* 246
  - *latissima* 248
- *Gloiopeltis furcata* 210
- *Gloiosiphonia verticillaris* 206
- *Gracilariopsis sjoestedtii* 232
- *Grateloupia californica* 212
- *Gymnogongrus linearis* 238
  - *platyphyllus* 240
- *Halicystis ovalis* 66
- *Halosaccion glandiforme* 260
- *Haplogloia andersonii* 88
- *Hedophyllum sessile* 136
- *Heterochordaria abietina* 90
- *Hymenena flabelligera* 292
  - *setchellii* 294
- *Iridæa cordata* 254
  - *lineare* 256
- *Laminaria groenlandica* 120
  - *saccharina* 122
  - *setchellii* 124
- *Laurencia spectabilis* 306
- *Leathesia difformis* 86
- *Lessoniopsis littoralis* 146
- *Macrocystis integrifolia* 144
- *Membranoptera platyphylla* 286
- *Microcladia borealis* 276
  - *coulteri* 278
- *Monostroma fuscum* 40
  - *zostericola* 42
- *Nemalion elminthoides* 178
- *Nereocystis luetkeana* 140
- *Odonthalia floccosa* 310
- *Opuntiella californica* 228
- *Pelvetiopsis limitata* 160
- *Percursaria percursa* 52
- *Petalonia debilis* 110
- *Phæostrophion irregulare* 118
- *Phyllospadix scouleri* 316
  - *torreyi* 318
- *Pleurophycus gardneri* 126
- *Plocamium pacificum* 230
- *Polyneura latissima* 290
- *Polysiphonia collinsii* 300
- *Porphyra perforata* 174
- *Postelsia palmæformis* 142
- *Prasiola meridionalis* 54
- *Prionitis lanceolata* 214
  - *lyallii* 216
- *Pterosiphonia bipinnata* 302
  - *dendroidea* 304
- *Pterygophora californica* 148

PAGE

Ptilota asplenioides 280
  hypnoides 282
  tenuis 284
Punctaria hesperia 102
Pylaiella littoralis 78
Ralfsia pacifica 82
Rhizoclonium riparium 56
Rhodoglossum affine 250
  latissimum 252
Rhodomela larix 308
Rhodoptilum plumosum 298
Rhodymenia palmata 262
  pertusa 264
Sargassum muticum 164

PAGE

Schizymenia pacifica 224
Scytosiphon bullosus 106
  lomentaria 108
Smithora naiadum 176
Soranthera ulvoidea 104
Sphacelaria racemosa 84
Spongomorpha coalita 64
Stenogramme interrupta 242
Ulothrix lætevirens 38
Ulva fenestrata 48
  lactuca 50
Urospora mirabilis 58
Zostera marina 313

Printed by A. SUTTON, Printer to the Queen's Most Excellent Majesty
in right of the Province of British Columbia.
1967

HANDBOOK SERIES
of the
BRITISH COLUMBIA PROVINCIAL MUSEUM
DEPARTMENT OF RECREATION AND CONSERVATION, VICTORIA, B.C.

No. 1.	Fifty Edible Plants of British Columbia.	G. A. Hardy.	(Discontinued.)
No. 2.	The Amphibians of British Columbia.	G. Clifford Carl.	50 cents.
No. 3.	The Reptiles of British Columbia.	G. Clifford Carl.	50 cents.
No. 4.	Some Mushrooms and Other Fungi of British Columbia.	G. A. Hardy.	(Discontinued.)
No. 5.	The Fresh-water Fishes of British Columbia.	G. Clifford Carl, W. A. Clemens, and C. C. Lindsey.	75 cents.
No. 6.	The Birds of British Columbia: (1) The Woodpeckers; (2) Crows and Their Allies.	C. J. Guiguet.	(Out of print.)
No. 7.	The Barnacles of British Columbia.	I. E. Cornwall.	(Out of print.)
No. 8.	The Birds of British Columbia: (3) The Shorebirds.	C. J. Guiguet.	(Out of print.)
No. 9.	The Grasses of British Columbia.	W. A. Hubbard.	(Out of print.)
No. 10.	The Birds of British Columbia: (4) Upland Game Birds.	C. J. Guiguet.	25 cents.
No. 11.	The Mammals of British Columbia.	I. McTaggart Cowan and C. J. Guiguet.	$2.
No. 12.	The Ferns and Fern-allies of British Columbia.	T. M. C. Taylor.	(Out of print.)
No. 13.	The Birds of British Columbia: (5) Gulls, Etc.	C. J. Guiguet.	25 cents.
No. 14.	Alien Animals in British Columbia.	G. C. Carl and C. J. Guiguet.	(Out of print.)
No. 15.	The Birds of British Columbia: (6) Waterfowl.	C. J. Guiguet.	25 cents.
No. 16.	The Orchids of British Columbia.	A. F. Szczawinski.	(Out of print.)
No. 17.	The Intertidal Bivalves.	D. B. Quayle.	50 cents.
No. 18.	The Birds of British Columbia: (7) Owls.	C. J. Guiguet.	25 cents.
No. 19.	The Heather Family (*Ericaceæ*) of British Columbia.	A. F. Szczawinski.	50 cents.
No. 20.	Guide to Common Edible Plants of British Columbia.	A. F. Szczawinski and G. A. Hardy.	50 cents.
No. 21.	Guide to Marine Life of British Columbia.	G. C. Carl.	50 cents.
No. 22.	The Birds of British Columbia: (8) Chickadees, Thrushes, and Others.	C. J. Guiguet.	25 cents.
No. 23.	Some Common Marine Fishes of British Columbia.	G. Clifford Carl.	50 cents.
No. 24.	Guide to Common Mushrooms of British Columbia.	R. J. Bandoni and A. F. Szczawinski.	50 cents.
No. 25.	The Lily Family (*Liliaceæ*) of British Columbia.	T. M. C. Taylor.	50 cents.
No. 26.	The Intertidal Univalves of British Columbia.	Lela M. Griffith.	50 cents.
No. 27.	Guide to Common Seaweeds of British Columbia.	Robert F. Scagel.	$1.

Other publications of the Provincial Museum are:—

Annual Reports: Covering the activities of the Museum each year.

Occasional Paper Series: Containing scientific papers in the fields of natural history and anthropology.

Anthropology in British Columbia Series: Reporting on activities of anthropology.

Special Publications: Containing material not included in other series.

Apply to the Provincial Museum of Natural History and Anthropology, Victoria, B.C., for copies of the above publications.